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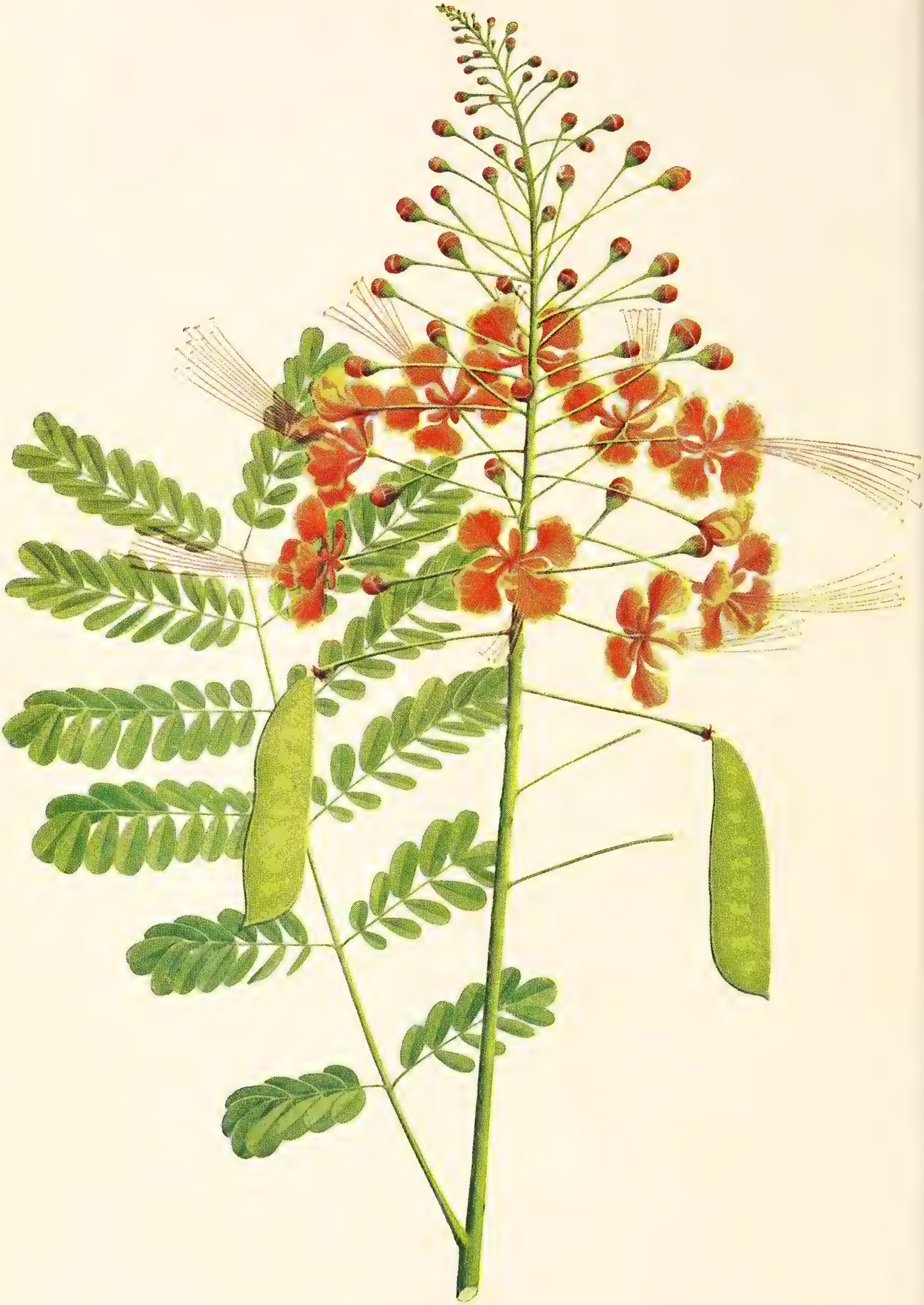

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CAESALPINIA PULCHERRIMA SW.

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SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.

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Part XXII.

[*Continued from Vol.* 45, *No.* 4. (1945), p. 461].

(*With* 1 *coloured*, 4 *black and white plates and* 7 *text-figures*).

Caesalpinia Linn.

A genus of trees, shrubs and woody climbers belonging to the family *Caesalpiniaceae.* The name perpetuates the memory of Andreas Caesalpinius, 1519-1603, an Italian botanist.

The *Caesalpiniaceae*, at one time considered to be a section of the *Leguminosae*, but now accepted by most botanists as a distinct family, is a very well defined group of plants. Its flowers are intermediate between the regular flowers of *Mimosaceae* and the extremely irregular flowers of *Papilionaceae*. The fruit, however, is the characteristic and familiar pod of the sweet pea family.

The genus *Caesalpinia* is well represented in India and several of the indigenous species as well as some exotics are cultivated in Indian gardens on account of their showy flowers and handsome foliage. The family comprises trees, shrubs and woody prickly climbers. The leaves are large and abruptly bipinnate. The flowers which are usually yellow, sometimes red, are arranged

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in large many-flowered racemes. The calyx consists of five segments which are imbricate in the bud. The petals are orbicular in shape with a distinct claw. Stamens ten in number, free. The ovary is sessile upon a disk and is usually few-ovuled. Pod various, sometimes covered with spines.

KEY TO THE SPECIES.

Stamens very long, much exceeding the petals.
Stamens 3-5 in. long; sepals hairy on the margins, flowers yellow. — *C. Gilliesii.*
Stamens less than 3 in. long; sepals glabrous, flowers red, red and yellow or yellow. — *C. pulcherrima.*
Stamens not very long, hardly exceeding the petals.
Pod prickly. — *C. Bonducello.*
Pod not prickly, dry.
Pod flat.
Large shrub or small tree. — *C. sappan.*
Climbing shrubs.
Leaflets 2-3 pairs. — *C. nuga.*
Leaflets 8-12 pairs. — *C. sepiaria.*
Pod twisted.
Climber; flowers in racemes. — *C. digyna.*
Large shrub or tree; flowers in dense panicle. — *C. coriaria.*

Caesalpinia Gilliesii Wall.

Bird of Paradise.

(Called after Dr. Gillies who introduced to Kew? in 1929 from South America).

Description.—An erect shrub attaining a height of 6-7 feet.

Branches round, striate, covered with small, circular, raised lenticels, nearly glabrous but sometimes covered with short, crisped, white hairs. Leaves alternate, compound, up to 1 ft. long, stipulate, bipinnate; stipules at the base of the main rhachis, ovate-acuminate in shape, ciliate or laciniate on the margins. Leaves abruptly bipinnate; pinnae opposite or alternate, up to 1.5 in. long, without stipellae; rhachis of the pinnae slightly swollen at the base. Leaflets oblong, 1/6 in. long, rounded at both ends, shortly petioluled, rather thick, with a definite row of black glands inside each margin on both surfaces.

Flowers arranged in a terminal raceme, rhachis thick, woolly and covered with numerous red-stalked glands. Individual flowers pedicellate, each pedicel being supported by an oavte-acuminate deciduous bract which is hairy and glandular on the back and glandular-subulate-laciniate on the margins; pedicel of the open flowers ·75 in. long. Calyx-tube short, turbinate, 1/6 in. long, glandular and hairy; calyx-lymb of five equal oblong segments covered on back and margins with flat-topped, shortly stalked glands, hairy outside, glabrous inside, about ·5 in. long, Petals five, of a beautiful yellow colour, shortly clawed, seated on the margin of the calyx-tube 1·5 in. long, obcordate in shape. Stamens 10, free, arising from the top of the calyx-tube; filaments

4-5 in. long, crimson in colour, glabrous. Anthers oblong, versatile. Ovary seated at the bottom of the calyx-tube, shortly stipitate, hairy, prolonged into a long style with a capitate stigma. Fruit a falcate, leathery pod, beaked, 2·5 in. long.

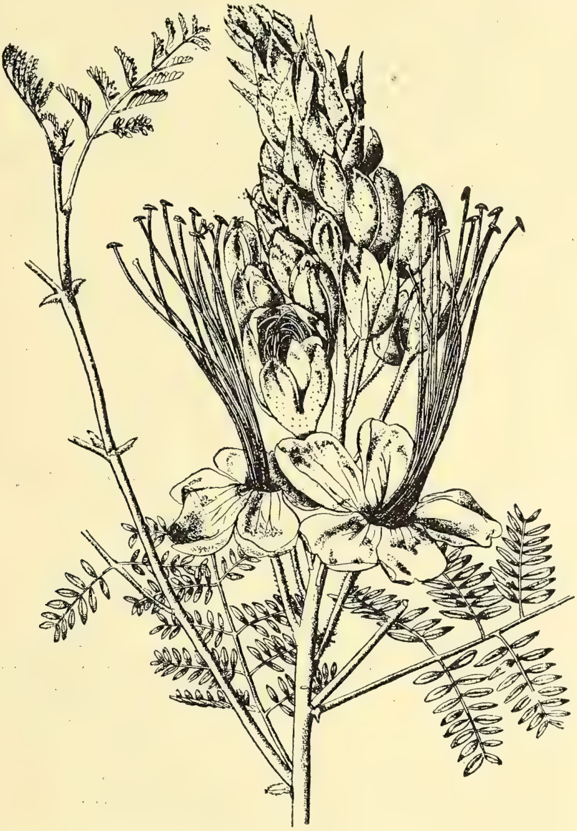

Fig. 1.—*Caesalpinia Gilliesii* Wall. × ½

Flowers.—Hot and rainy season. *Fruits.*—July-August.

Distribution.—Native of Mendoza, South America, now frequently cultivated in all tropical and subtropical parts of the world.

Gardening.—A very hardy shrub reaching up to 7 ft. in Dehra, with graceful feathery, bipinnate foliage of small leaflets. It flowers profusely during the hot and rainy seasons, the flowers being of a pale-yellow colour, the petals seldom fully expanding but the long stamens which are crimson in colour protrude. After two seasons or so the plant is apt to decay and look unsightly; it is consequently advisable to replace it by fresh seed. In Dehra Dun and elsewhere in this country the pods are frequently attacked by a borer which destroys the seeds. They should, therefore, be covered with muslin to protect them from the ravages of these insects. Easily raised from seed sown during the rains or even earlier. According to Sir W. J. Hooker it was introduced by Dr. Gillies into the Royal Botanic Gardens, Kew, in 1829. It is popularly known as Dr. Gillies *Poinciana*, as Hooker, when the plant was first discovered, described it as *Poinciana Gilliesii.* It is a hardy plant and can be grown out of doors in England.

Caesalpinia pulcherrima Swartz.

Dwarf Poinciana; Barbados Pride; Peacock flower.
(*Pulcherrima* means most beautiful in Latin).

Description.—A handsome shrub reaching 6 ft. in height. Branches smooth, green or glaucous, glabrous, shining, with a few prickles here and there. Leaves abruptly bipinnate, stipulate, up to 1·5 ft. long; pinnae 6-12 pairs, opposite, with small stipellae at the base, up to 3 in. long; leaflets oblong, ·5 in. long, oblique at the base, emarginate at the apex with the midrib produced as a short mucro, very shortly stalked; each leaflet with a very small pair of stipels at the base of the stalk.

Flowers arranged in an erect terminal raceme. Flowers pedicelled; the pedicels of the fully opened flower being up to 4 in. long; pedicels supported at the base by a rapidly deciduous, lanceolate-acuminate bract, ·1 in. long, which can be seen at the apex of the raceme surrounding the young flowers. Calyx-tube turbinate, ·2 in. long, glabrous; limb 4-partite, one sepal larger than the others, hooded, glabrous, coloured red or orange in the bud. Petals about ·75 in. long, distinctly clawed; limb orbicular in shape, often lobed on the margins, variously coloured in red and gold, very often claw and centre of limb crimson, red or golden-red, with a narrow margin of gold. Stamens 10, free, seated on the margin of the calyx-tube; filaments long, red, rather thick at the base where they are covered with white hairs, 2·25 in. long, tapering to the versatile anthers. Ovary seated on a short gynophore arising from the base of the calyx-tube, glabrous, compressed, terminating in a long yellowish red style. Pod nearly straight, narrow and thin, 2-3 in. long.

Flowers.—Hot and rainy seasons. *Fruits.*—Cold season.

Distribution.—Native country uncertain, perhaps South America. Extensively cultivated throughout the tropics.

Gardening.—A hardy, drought resistent, showy shrub up to 6 ft. or so in height. It flowers profusely during the hot and rainy season making the plant very ornamental. It should be cut in closely in the cold season, as it is apt to grow very straggly and becomes unsightly. It can hardly stand the cold of the Punjab but flourishes there and in the United Provinces better in the hot and rainy seasons than in Bengal. It is better to replace old plants every now and then by fresh plants raised from seed. This plant starts to flower as early as 8 months old. It is best suited for growing on lawns and for hedging. Easily raised from seed which it produces abundantly. According to

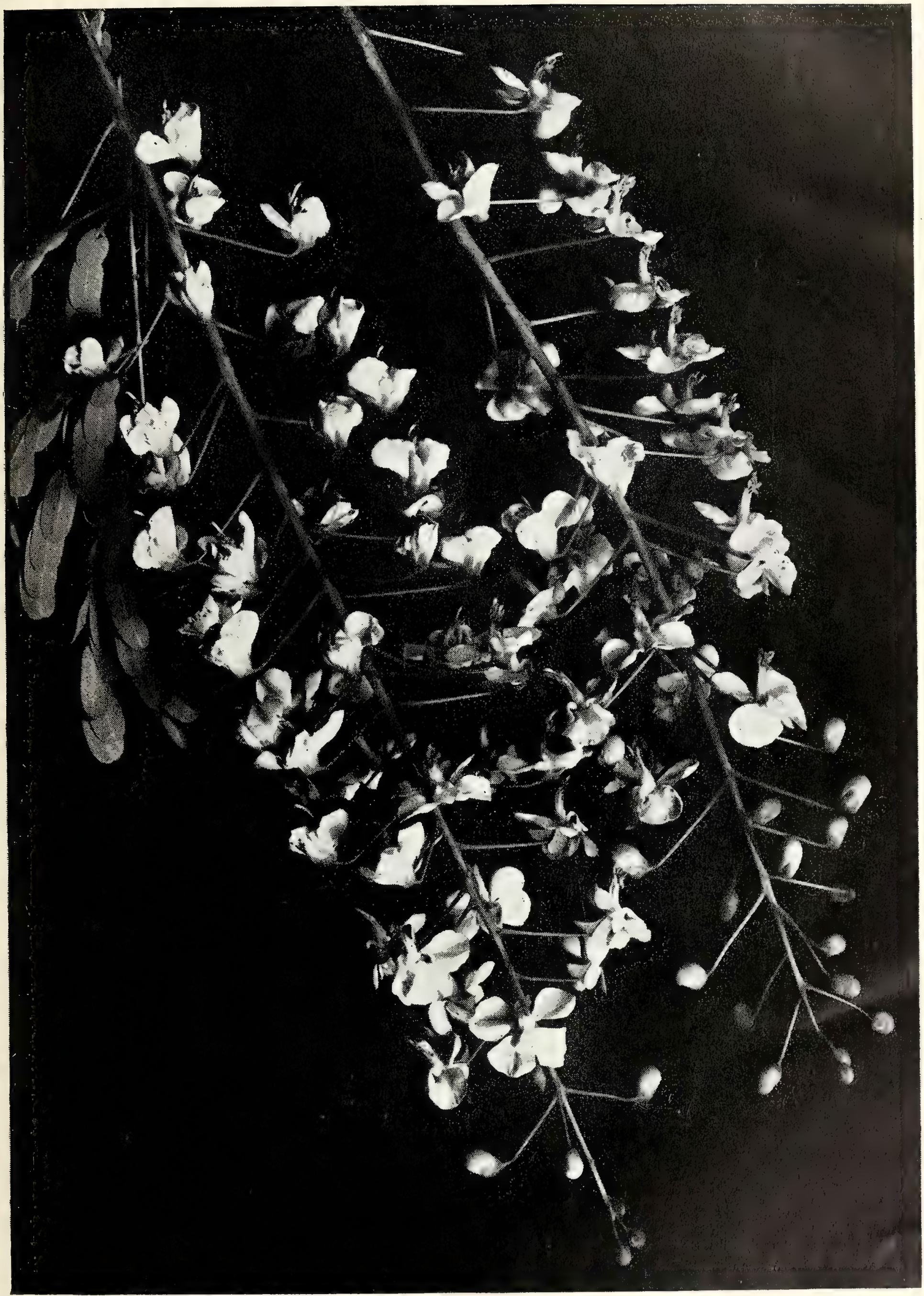

Photo by M. N. BAKSHI

Caesalpinia sepiaria Roxb.
New Forest, Dehra Dun.

Photo by M. N. BAKSHI

Caesalpinia sepiaria Roxb.
New Forest, Dehra Dun.

Rheede, Hortus Malabaricus, it was in the gardens of India in 1680. It was introduced into Holland from Amboyna about the year 1670. On account of its showy flowers and attractive, finely divided foliage, this plant is a great favourite in all tropical and subtropical countries. Although this shrub will thrive in poor soil, an application of manure or chemical fertilizer may be given to advantage causing it to make more vigorous growth and give better and larger heads of flowers.

C. pulcherrima Sw. var. *flava* Hort. A race with bright yellow flowers, not nearly so handsome as the type. It is called 'Radha chura' in this country, the red race being named as 'Krishna chura'.

Medicinal and economic uses.—Burkill (Economic Products of the Malay Peninsula) remarks that this plant has a few medicinal uses in the Dutch Indies. The pounded roots are said to be useful in cases of infantile convulsions. The flowers are used as a remedy for intestinal worms, for coughs and chronic catarrh. The leaves are reputed to have a purgative action, and also to be abortificient. A decoction of the leaves is said to be useful in cases of fever.

Caesalpinia Bonducella Fleming [*C. crista* Linn.].

Fever-Nut; Physic-Nut.

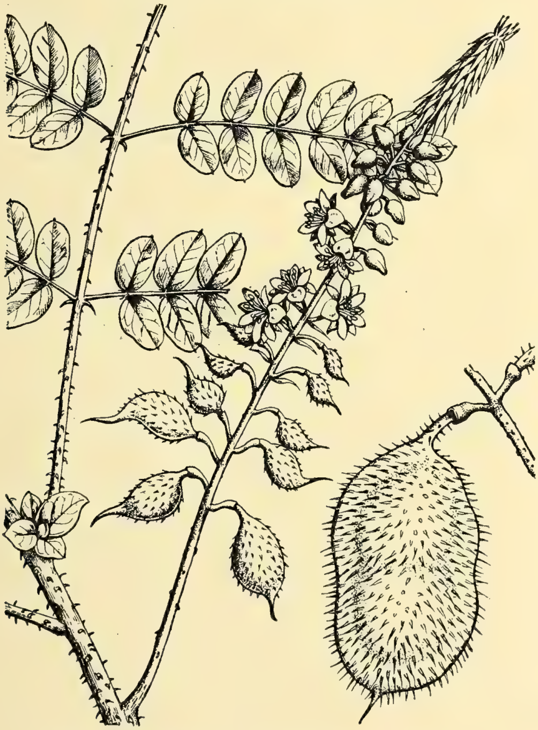

Fig. 2.—*Caesalpinia Bonducella* Fleming. ×½

Description.—A prickly shrub, rambling or scandent. Branches more or less covered with short, soft hairs and armed with stout, sharp, straight or recurved prickles. Leaves compound 12-18 in. long, abruptly bipinnate, with the rhachis often produced as a short mucro; rhachis stout, covered with very short brown hairs and bearing sharp recurved prickles; pinnae up to 16 pairs, opposite; base of the rhachis of the pinnae with recurved stipellate spines. Stipules large, foliaceous, often lobed. Leaflets 6-10 pairs seated on very short pedicels with a pair of recurved prickles at the base, somewhat oblique at the base, oblong or elliptic, obtuse with the midrib produced as a short mucro, glabrous or sparsely hairy above, puberulous below.

Flowers arranged in axillary or terminal racemes, bracteate; bracts linear-lanceolate, tip subulate, ·4-·5 in. long, covered with rusty-brown hairs. Flowers pedicelled; pedicel ·2-·3 in. long, rusty tomentose. Calyx-tube very short; lobes 5, ·2-·3 in. long, rusty tomentose on both surfaces. Petals 5, golden yellow or the uppermost sometimes spotted with red, oblanceolate in shape. Stamens 10; filaments short, hardly exceeding the petals, covered with white hairs below. Ovary seated on a short gynophore which comes from the base of the calyx-tube. Pod broadly elliptic in shape, beaked, coriaceous, 2-3 in. long, covered all over with sharp wiry prickles.

Flowers.—August-September. *Fruits.*—Cold season.

Distribution.—Wild or naturalized throughout the tropics.

Gardening.—A scandent prickly shrub with yellow flowers which are produced during the rains. It is commonly met with in a wild state in abandoned village sites or in hedges. It makes an effective hedge-plant. Propagated easily from seed.

Medicinal and economic uses.—This plant, which bears the Sanskrit name of 'Pulikaranja', has long enjoyed a reputation for medicinal properties and was well known to Clusius and Rumphius. The leaves and seeds possess a substance known as bonducin of which the properties are not yet fully known. The substance is extremely bitter and appears to be absent from the roots. In India the seeds as well as the leaves are much used in native medicine to relieve colic, fever, hydrocele, diarrhoea and rheumatism.

Caesalpinia Sappan Linn.

Sappan Wood.

(The specific name comes from its local name, *sepang*, in Java).

Description.—A thorny, shrubby tree reaching a height of about 20 ft. and a diameter of 6-10 in. Leaves up to 18 in. long, stipulate alternate, with 16-24 pinnae, each 4-6 in. long. Leaflets 20-36, chartaceous, oblong, very oblique at the base, almost sessile, rounded and slightly emarginate at the apex, glabrous above, puberulous below.

Flowers in panicled racemes, 12-16 in. long; separate racemes 4-6 in. long. Calyx-tube short, bowl-shaped; lobes ·4 in. long, 5 in number. Petals 5, orbicular, ·3 in. long, yellow; base of upper petal pink. Stamens 10 free, arising from the lip of the calyx-tube; filaments white, woolly in the lower half. Ovary stipitate, grey-velvety. Pod woody, oblong, flattened, 3-4 in. long, 1·5-2 in. wide, polished, brown, beaked.

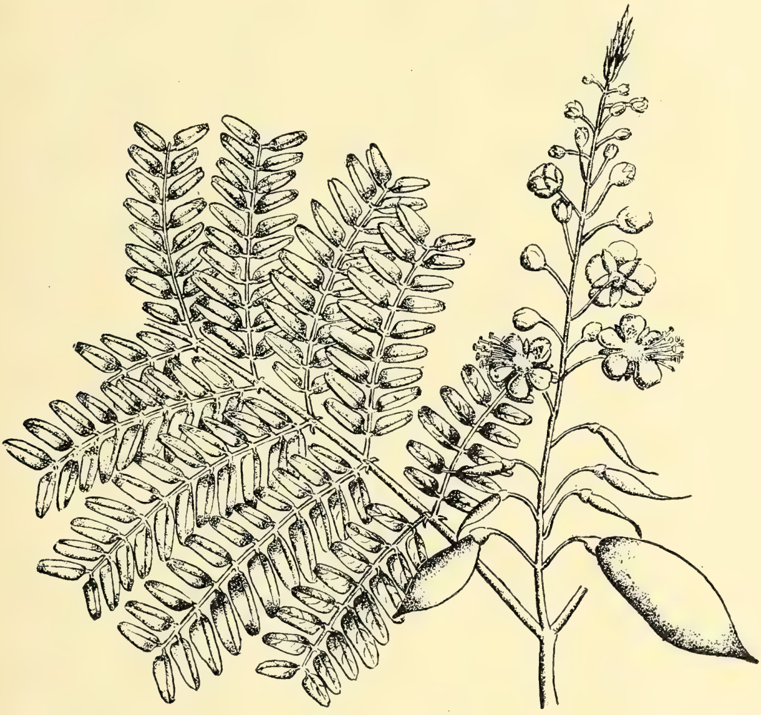

Fig. 3.—*Caesalpinia Sappan* Linn. × $\frac{1}{3}$

Flowers.—Rainy season. *Fruits.*—Cold season.

Distribution.—From India throughout Malaysia.

Gardening.—A large thorny shrub quite ornamental when laden with its large panicles of yellow flowers. Easily propagated from seed which it produces abundantly.

Medicinal and economic uses.—The wood yields a beautiful red dye which is used to colour silk. The dye is also used for colouring starch which is scattered on the occasion of the Holi festival.

Caesalpinia nuga Ait.

Description.—A stiff, wiry, prickly climber with a blackish bark and few prickles. Leaves alternate with small stipules, bipinnate, 6-12 in. long, with 6-8 pinnae, often much less on flowering branches, rhachis with recurved spines. Rhachis of the pinnae with recurved stipular spines at the base. Leaflets 2-3 pairs, light green above, rather pale below, coriaceous, ovate or elliptic, acute or obtuse, 1-2·5 in. long, ·5 to 1 in. wide.

Inflorescence a panicle of racemes; racemes racemosely arranged up to 6 in. long. Flowers fragrant, seated on pedicels, ·3 in. long. Calyx broadly obconic, very short (·1 in. long), smooth, glabrous, 10-ribbed; limb consisting of 5 sepals, oblong, smooth and glabrous. Petals 5, yellow, clawed; limb orbicular crumpled; upper spotted with red; stamens ten, free; filaments hardly longer than the petals, dilated at the base and woolly below; anthers versatile. Ovary seated on an oblique gynophore, elliptic-compressed, sparsely hairy; style short. Pod turgid, beaked, indehiscent, 2 in. long.

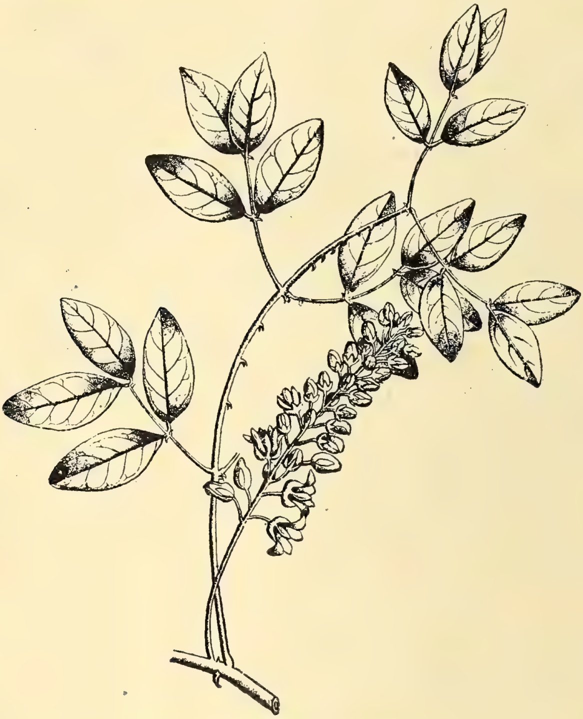

Fig. 4.—*Caesalpinia nuga* Ait. ×½

Flowers.—May-October. *Fruits.* Cold season.

Distribution.—Found from Bengal to the Pacific, chiefly along the coast, but also inland.

Gardening.—A vigorous prickly climber with yellow flowers which against the glossy green leaves appear quite ornamental. Readily propagated by seed which (as in all other species of this genus) should be well soaked in warm water for some hours before sowing.

Medicinal and economic uses.—The roots of this plant are stated to be diuretic by Watt. The same authority remarks that the roots as well as the roasted seeds are used externally as well as internally in diseases of the eye. In India the lac insect feeds on this plant.

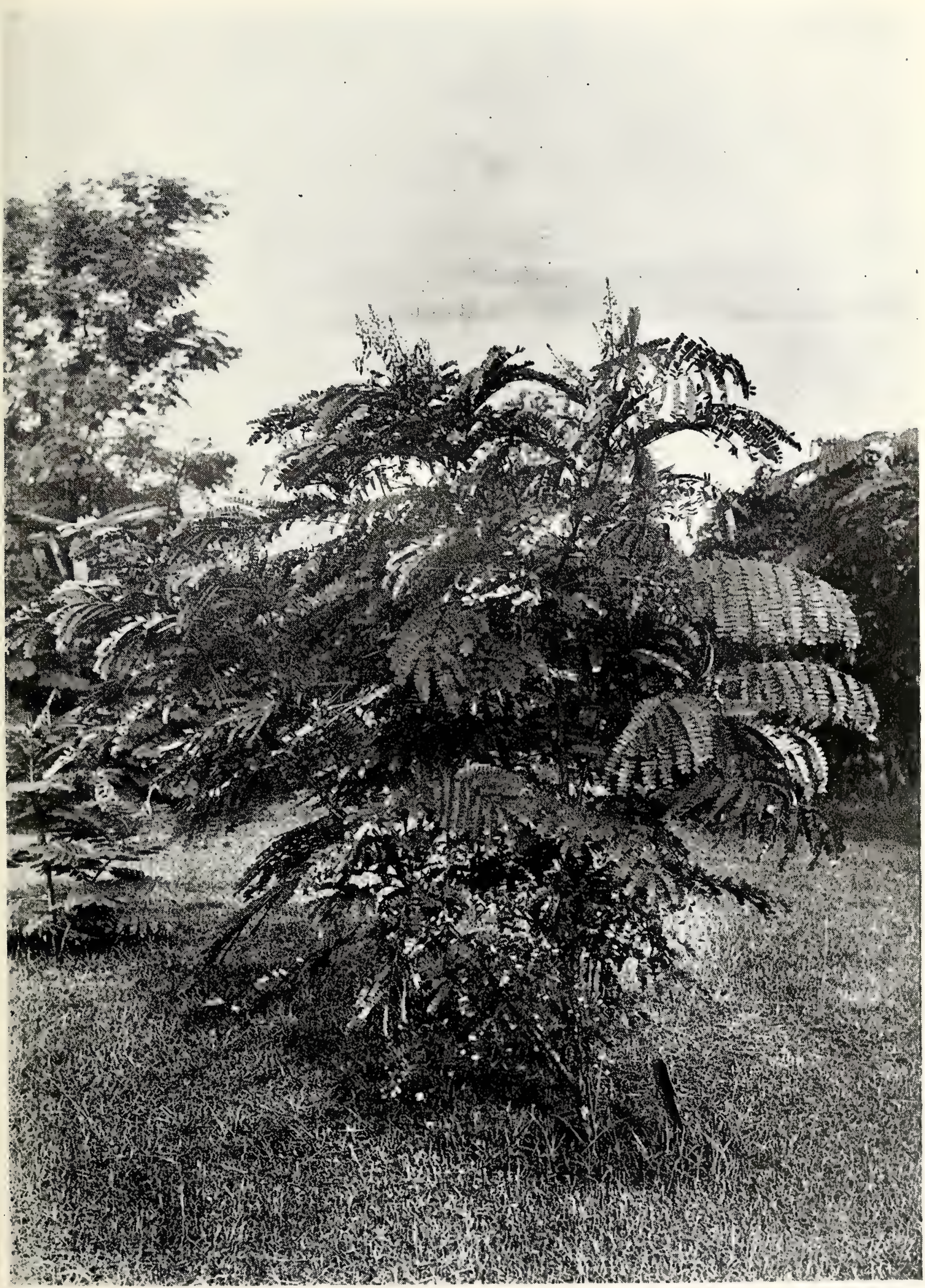

Photo by M. N. BAKSHI

Caesalpinia sappan Linn.
New Forest, Dehra Dun.

Photo by M. N. Bakshi

Caesalpinia pulcherrima Sw.
New Forest, Dehra Dun.

Caesalpinia sepiaria Roxb.

The Mysore-thorn.

(*Sepiaria* is derived from the Latin verb *saepio,* to surround with a hedge, as this plant is often used as an impenetrable hedge).

Description.—A branchy scrambling or scandent shrub with dark red bark; branches glabrous or covered with dense rusty or golden-brown pubescence. Prickles numerous, recurved, stout. Leaves compound, bipinnate, up to 1 ft. long, stipulate; stipules small, caducous. Pinnae opposite, stalked with a pair of recurved stipular thorns at the base, 6-10 pairs; leaflets rather thin, 8-12 pairs, shortly stalked, opposite, oblong, obtuse at both ends, emarginate at the apex, puberulous on the lower surface, green above, pale below.

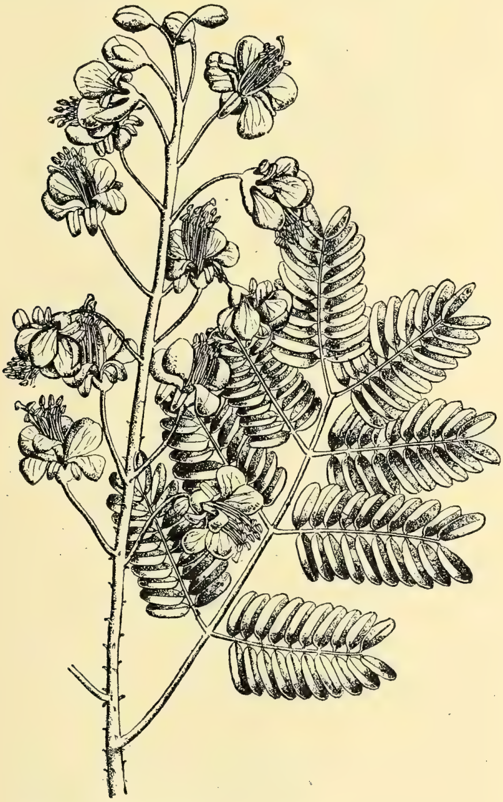

Fig. 5.—*Caesalpinia sepiaria* Roxb. × $\frac{1}{2}$

Inflorescence a terminal, erect raceme, many-flowered. Individual flowers set obliquely on pedicles 1·25 in. long; pedicels ascending. Main rhachis of the raceme and pedicels fulvous hairy. Calyx-tube a broad inverted cone, fulvous hairy, 10-ribbed, ·15 in.

long. Sepals 5, oblong, covered outside with golden hairs, glabrous inside, ·3 in. long. Petals 5, obovate-obtuse, ·5 in. long yellow, becoming reflexed as the flower opens fully to expose the bases of the filaments. Stamens 10, free, arising from the lip of the calyx tube. Filaments flattened at the base and distinctly woolly, ·4 in. long; anthers versatile. Ovary seated on an oblique gynophore arises from the base of the calyx-tube, flattened-oblong, hairy. Style short. Pod beaked, 3-5 in. long, woody, glabrous, recurved, indehiscent, with the upper suture expanded into a narrow wing.

Flowers.—March-June. *Fruits.*—Rainy season.

Distribution.—Indigenous and naturalized throughout India and Burma (ascending to 5,000 ft. in Jaunsar), extending to Ceylon, the Malay Archipelago, China and Japan.

Gardening.—A large prickly climber. The large racemes of bright yellow flowers make a fine show. It makes an excellent hedge plant. Easily raised from seed.

Medicinal and economic uses.—This creeper, thanks to its prickly nature and very close mode of growth, is much used by Nagas as one of their village defences. The Nagas of Henima in days gone by, grew it very thickly around the village. The branches were erected on forked poles over the paths into the village during the day while at night the poles were removed and the creeper laid on the ground forming an impenetrable barrier to any marauder. This creeper may be seen to this day near the village entrance of most Angami villages.

The bark is said to be used for tanning in South India. It is also stated that the lac insect feeds on this species.

Caesalpinia digyna Rottl.

Description.—A large, scandent, prickly shrub. Bark dark brown or dark red with plentiful, strong, recurved prickles. Leaves alternate, compound, bipinnate, stipulate, 6-12 in. long, with 8-12 pairs of pinnae; stipules lanceolate, small, caducous; rhachis sparsely hairy or glabrescent. Pinnae up to 2 in. long, shortly petioled at the base, with a pair of stipular thorns. Leaflets 7-10 pairs, ·3 in. long, rounded at the top, slightly and obliquely cordate at the base, very shortly stalked; rhachis hairy.

Flowers yellow, arranged in terminal or supra-axillary racemes. Individual flowers numerous, seated on pedicels up to ·8 in. long; bracts very small, caducous. Calyx-tube very short, almost salver-shaped, glabrescent with age; sepals five, oblong, hooded, rounded at the top, imbricate in the bud, the upper arching over the others and falling as the flower opens. Petals 5, inserted on the lip of the calyx-tube, orbicular, obovate or oblong, rounded at the apex, very shortly clawed, ·25 in. long. Stamens 10, free, inserted on the lip of the calyx-tube; filaments dilated at the base and very woolly. Pod fleshy, shortly stipitate, 1·5-2·5 in. long, beaked, 1-2 seeded, twisted.

Flowers.—Rainy season. *Fruits.*—Cold season.

Distribution.—Found in India, extending to the Malay Peninsula and Ceylon.

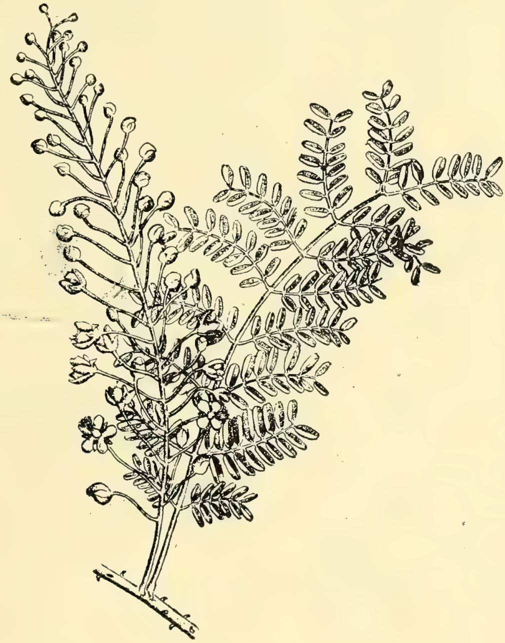

Fig. 6.—*Caesalpinia digyna* Rottl. × ½

Gardening.—A large woody prickly climber. It flowers abundantly during the rains, the petals being yellow streaked with red. Propagation is by seeds which are very hard and must be kept in hot water overnight or filed or injured in some other way before they will germinate.

Medicinal and economic uses.—The pods of this plant contain an excellent tanning material. The roots are said to be of use in phthisis and scrophulous affections.

Caesalpinia coriaria Willd.

The Divi-divi plant; American Sumach.

(*Coriaria* is a Latin word derived from *corium*, a hide or skin, and refers to the use of the pods of this plant as a tanning material).

Description.—A large bush or sometimes a small tree with mimosa-like foliage on unarmed stems. Leaves compound, bipinnate; pinnae impari- or pari-pinnate, up to 6 in. long. Leaflets very numerous and narrow, ·25 in. long, linear, green above, pale below, slightly obliquely-cordate at the base, emarginate at the apex, shortly stalked; main rhachis and rhachis of the pinnae hairy.

Flowers arranged in axillary and terminal dense panicles up to 2 in. long. Individual flowers on short pedicels, bud ·2 in. long. Calyx-tube minute; lobes 5, oblong, rounded at the top, 1/6 in. long. Petals 5, inserted on the lip of the calyx-tube, spatheate, yellow. Stamens 10, free, arising from the lip of the calyx-tube, dilated at the base and hairy in the lower half; anthers versatile. Ovary stipitate, glabrous; style short. Pod twisted, thin, up to 3 in· long by ·5 in. wide.

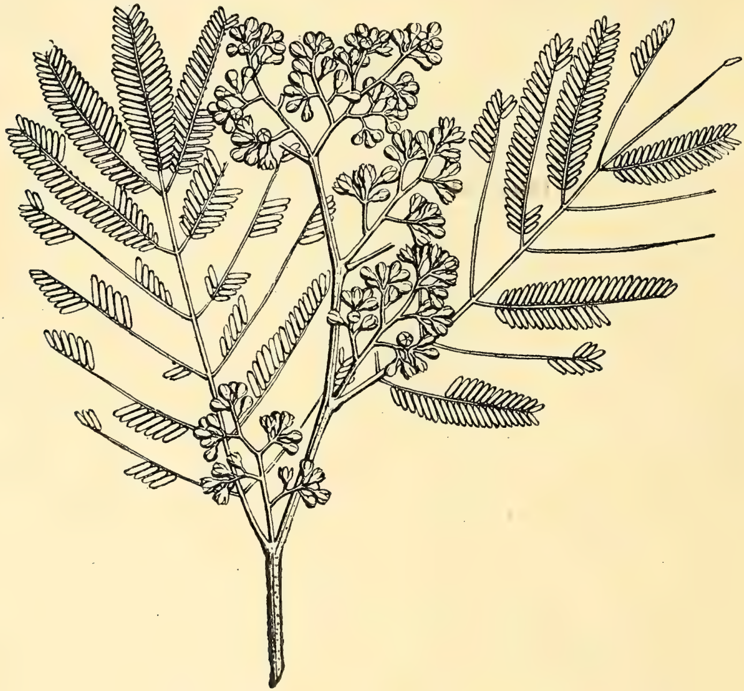

Fig. 7.—*Caesalpinia coriaria* Willd. ×¼

Flowers.—Sept.-Oct. *Fruits*.—Cold season.

Distribution.—Native of the West Indies and Central America, now grown in gardens in this country.

Gardening.—A spreading umbrella-shaped tree with dark green foliage and delightfully scented pale yellow flowers, suitable for planting in compounds. It is easily raised from seed, but is rather sensitive to frost.

Medicinal and economic uses.—The pods of this tree contain a powerful tanning material and it is much cultivated in South India.

(*To be continued.*)

FIELD NOTES ON THE BIRDS OF COASTAL ARAKAN AND THE FOOTHILLS OF THE YOMAS.

BY

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These notes have been compiled during the Arakan campaigns of 1943 to 1945.

Subspecific names have not been added as we were unable to secure a series for comparison, owing to lack of suitable ammunition. Doubtful species, however, were shot for identification.

These notes deal with the sandy beaches, tidal waterways, mangrove swamps, scrub-covered islands, the villages and paddy-fields, and the foothills up to 2,000 ft. which rise from the coastal region often almost directly, and are covered with a variety of dense mixed tropical jungle, with scrub, or with pure bamboo jungle.

In the dry season, December to May, fresh water is very scarce and local, and practically all the hill streams are dry. In the monsoon, June to November, the rainfall is very heavy, averaging some 190 inches.

It is hoped that these notes may provide a foundation for a more critical study of the avifauna of Arakan at some future date, and may prove of value in the preparation of the second edition of the Birds of Burma.

ORDER : *PASSERES.*

FAMILY : CORVIDAE.

Corvus macrorhynchos. Jungle Crow.

Common.

C. splendens. House Crow.

Common about the village and tidal waters. Indian and Burmese races are found together in North Ramree Island. Akyab, Myebon, and Baronga Island. South of this area only the Burmese race is found.

Cissa chinensis. Green Magpie.

Foothills. One in May, blue being dominant colour. One in November in fresh green plumage in Ngakyedauk Pass.

Dendrocitta vagabunda. Indian Tree Pie.

Common in the low ground.

Garrulus leucotis. Burmese Jay.

Sparsely distributed in the jungles North and South of Ruywa.

FAMILY : TIMALIIDAE.

Garrulax pectoralis. Black-gorgetted Laughing Thrush.

Local in hill jungle, and even at sea level in winter.

Pellorneum ruficeps. Spotted Babbler.

Common in open lower jungle.

Argya earlii. Striated Babbler.

Old grassy rice furrows. Scarce.

A. longirostris. Slender-billed Babbler.

Fairly common in low ground.

Timalia pileata. Red-capped Babbler.

Local in foothills. Found nesting in June.

Chrysomma sinensis. Yellow-eyed Babbler.

Local in scrub jungle near the coast, and in patches of open country out of cultivation.

Mixornis rubricapilla. Yellow-breasted Babbler.

Common in the jungle.

Pomatorhinus hypoleucus. Arakan Scimitar Babbler.

Scarce. Foothills of Mayu Range in bamboo.

Aegithina tiphia. The Iora.

Common in open jungle and round camps.

Chloropsis jerdoni. Jerdon's Chloropsis.

Very uncommon. Low ground villages only in North Arakan.

C. aurifrons. Gold-fronted Chloropsis.

Common in foothills and round camps. This is the common Chloropsis of Arakan.

C. cochinchinensis. Burmese Chloropsis.

Uncommon. None seen North of Tamandu on Dalet Chaung.

FAMILY : PYCNONOTIDAE.

Molpastes cafer. Red-vented Bulbul.

Very common.

Otocompsa jocosa. Red-whiskered Bulbul.

Very common.

O. flaviventris. Black-crested Yellow Bulbul.

Common in the foothills.

Iole virescens. Olive Bulbul.

Occurs in the thick Yoma jungle. Very secretive.

Alcurus leucogrammicus. Striated Green Bulbul.

Apparently locally migrant as not observed in April-October. One 5 January. One 7 March.

Microtarsus atriceps. Black-headed Bulbul.

Rare winter visitor.

Microscelis psaroides. Black Bulbul.

Apparently a winter visitor from the higher hills. Latest 21 March.

Criniger flaveolus. White-throated Bulbul.

Sparsely distributed along the coastal hill jungles, and in winter along the coastal belt. Seen in parties of up to 10.

FAMILY : TURDIDAE.

Saxicola caprata. Pied Bushchat.

Common round the coastal villages.

S. torquata. Stonechat.

Winter visitor to the coastal strip October-March.

Enicurus immaculatus. Black-backed Forktail.

Common. The only Forktail seen.

Calliope calliope. Rubythroat.

Winter visitor. Leaves in early March.

Copsychus saularis. Magpie Robin.

Very common.

Kittacincla malabarica. Shama.

Uncommon, but occurs as its song has been heard on one or two occasions, and one observed 25 October. Probably nesting in June and July.

Monticola cinclorhyncha. Blue-headed Rock Thrush.

Sparse winter visitor. Earliest 24 September. Latest 24 April.

M. solitaria. Eastern Blue Rock Thrush.

Earliest 1 October, latest 5 May. Common in winter.

Miyophonus caeruleus. Whistling Thrush.

Winter visitor to the hill streams, being locally migrant as they dry up.

Geokichla citrina. Orange-headed Ground Thrush.

One in a bamboo thicket 12 March. Another 10 February.

FAMILY : MUSCICAPIDAE.

Muscicapa parva. Red-breasted Flycatcher.

Very common in winter. First arrival 30 September. Latest 30 April.

Muscicapula rubeculoides. Blue-throated Flycatcher.

Common winter visitor to the foothills.

Culicicapa ceylonensis. Grey-headed Flycatcher.

Winter visitor in fair numbers to the thicker jungle from the higher hills.

Alseonax latirostris. Brown Flycatcher.

Sparsely distributed in the heavier jungle.

Hemipus picatus. Pied Shrike.

One 12 November, Mayu.

Rhipidura aureola. White-browed Fantail Flycatcher.

Sparsely distributed about village gardens.

Hypothymis azurea. Black-naped Flycatcher.

Sparsely distributed in the bamboo and thicker shadier jungles.

Tchitra paradisi. Paradise Flycatcher.

On winter passage from Duars. Chestnut phase of plumage usual, but one in white phase seen 10 November.

FAMILY: LANIIDAE.

Lanius cristatus. Brown Shrike.

Very common in winter. First arrivals 6 September. Latest 4 May.

L. nepalensis. Grey-backed Shrike.

Winter only.

L. nasutus. Black-headed Shrike.

One 31 October. One 15 November in foothills.

L. colluroides. Burmese Shrike.

Winter visitor from 3 October to foothills.

Tephrodornis pondicerianus. Wood-Shrike.

Sparsely distributed around villages. One 7 July. A pair 5 January.

FAMILY: CAMPEPHAGIDAE.

Pericrocotus roseus. Rosy Minivet.

Several flocks seen and specimens secured in March and April.

P. peregrinus. Little Minivet.

A few flocks observed in the open jungles in October contained only males. Breeds in the Casuarina trees on the coast north of Akyab and at Teknaf. Also seen at Ruywa.

P. speciosus. Scarlet Minivet.

A pair on the Mayu Range 7 November. Resident.

Lalage sykesi. Black-headed Cuckoo-shrike.

Winter visitor in small numbers arriving about mid-October, leaving in April.

Graucalus novaehollandiae. Large Cuckoo-shrike.

Common among the wood oil trees in the lower jungles.

FAMILY : ARTAMIDAE.

Artamus fuscus. Ashy Swallow-shrike.

Common.

FAMILY : DICRURIDAE.

Dicrurus macrocercus. King Crow.

Common in the North. Scarce and local South of Maungdaw.

D. leucophæus. Ashy Drongo.

Pair 12 October. One 21 January. Sparse winter visitor.

Chaptia aenea. Bronzed Drongo.

Thick jungle. Very local, but usually to be seen in same area.

Dissemurus paradiseus. Large Racket-tailed Drongo.

Common in deciduous jungle.

Bhringa remifer. Lesser Racket-tailed Drongo.

Less common than the last named.

Chibia hottentotta. Hair-crested Drongo.

The most common of all the Drongos and well distributed.

FAMILY : SYLVIDAE.

Acrocephalus stentoreus. Great Reed Warbler.

Local winter visitor to suitable reed-beds and clumps of pine-apple. In full song, 1 May at Akyab.

A. agricola. Paddyfield Warbler.

Rather scarce. Local winter visitor.

A. dumetorum. Blyth's Reed Warbler.

As above.

Megalurus palustris. Striated Marsh Warbler.

Common in the coastal belt from about 10 October to 15 April.

Orthotomus sutorius. Tailor Bird.

Common.

Franklinia gracilis. Franklin's Wren-warbler.

Common in scrub jungle.

Prinia flaviventris. Yellow-bellied Wren-warbler.

Common in coastal plain in winter.

Cisticola juncidis. The Streaked Fantail Warbler.

Fairly common in the coastal plain. Resident.

Horeites brunnifrons. Rufus-capped Bush Warbler.

Common winter visitor to scrub jungle.

Phylloscopus fuscatus. Dusky willow warbler.

Common in winter in the coastal swamps.

FAMILY: IRENIDAE.

Irena puella. Fairy Bluebird.

Small parties of 5 or 6 seen on several occasions, in the tall trees in thick mixed jungle. Common in the Mayu Range.

FAMILY: ORIOLIDAE.

Oriolus xanthornus. Black-headed Oriole.

Common.

O. chinensis. Black-naped Oriole.

One 15 March. Pair nesting April in Yoma foothills. Uncommon and not seen in the coastal belt. One at Akyab 12 April.

FAMILY: GRACULIDAE.

Gracula religiosa. Indian Grackle.

Fairly common where there are high trees in the open.

FAMILY: STURNIDAE.

Aplonis panayensis. Glossy Stare.

Very local. Nests in old holes of woodpeckers in May. One found at sea-level and watched till young hatched.

Sturnia malabarica. Grey-headed Myna.

Common.

Acridotheres tristis. Common Myna.

Very common.

Æthiopsar fuscus. Jungle Myna.

Very common.

Sturnopastor contra. Pied Myna.

Very common.

Gracupica burmanicus. Jerdon's Myna.

Flock of 20, 15 October in foothills.

FAMILY: PLOCEIDAE.

Ploceus infortunatus. Eastern Weaver Bird.

Common.

P. manyar. Striated Weaver Bird.

Very local in reed-beds, but occurs in suitable localities and breeds.

Lonchura punctulata. Spotted Munia.

Winter visitor in small flocks.

L. striata. Striated Munia.

Common in flocks in the foothills April-January and in late September. Absent in the monsoon and in winter.

L. atricapilla. Chestnut-bellied Munia.

Very common. Nest with eggs 22 November shows this species is not necessarily a pre-monsoon nester.

FAMILY : FRINGILLIDAE.

Passer domesticus. House Sparrow.

Common around villages.

P. flaveolus. Pegu House Sparrow.

Very local. Observed on the islands off the coast at Ruywa in March, and one cock watched near Ruywa on the mainland.

Emberiza aureola. Yellow-breasted Bunting.

Singly and in flocks in winter and on passage.

FAMILY : HIRUNDINIDAE.

Riparia riparia. Eastern Sand-Martin.

A few in winter only.

R. paludicola. Indian Sand-Martin.

Common.

Hirundo rustica. Eastern Swallow.

Very common in winter.

H. tytleri. Tytler's Swallow.

Common in winter.

H. daurica. Red-rumped Swallow.

Common in winter.

H. smithii. Wire-tailed Swallow.

Fairly common in winter.

FAMILY : MOTACILLIDAE.

Dendronanthus indicus. Forest Wagtail.

Sparsely distributed in the thicker jungle.

Motacilla alba. White Wagtail.

Common in winter.

M. cinerea. Grey Wagtail.

Common in winter.

M. flava thunbergi. Grey-headed Yellow Wagtail.

A few on passage singly. All in April.

M. flava beema. Yellow Wagtail.

One 20 April. One 24 April. One 21 November.

M. citreola. Yellow-headed Wagtail.

One 14 May. Fairly common on passage, especially in April, and spends the winter.

Anthus rufulus. Indian Pipit.

Common and resident.

A. hodgsoni. Indian Tree-Pipit.

Common winter visitor.

A. richardi. Richard's Pipit.

Common winter visitor.

A. cervinus. Red-throated Pipit.

Winter visitor and passage migrant. Uncommon.

FAMILY: ALAUDIDAE.

Alauda galgula. Indian Skylark.

Rather scarce and locally migratory in the wet season.

Mirafra assamica. Bengal Bush-Lark.

Very common in the low ground.

FAMILY: ZOSTEROPIDAE.

Zosterops palpebrosa. White-eye.

Rather local; not common. Coastal plain and edge of foothills.

FAMILY: NECTARINIDAE.

Cinnyris asiaticus. Purple Sunbird.

Fairly common. Nests in March-April in coastal plain.

C. zeylonicus. Purple-rumped Sunbird.

Fairly common.

C. flammaxillaris. Yellow-breasted Sunbird.

Fairly common on the coastal plain south of Akyab.

C. brasiliana. Van Hasselt's Sunbird.

Very local, but haunts same places. Smythies' description does not do this lovely bird justice.

Æthopyga siparaja. Yellow-backed Sunbird.

The most common Sunbird.

Anthreptes malaccensis. Brown-throated Sunbird.

Not common. Observed in Mar. near Myebon, and two other records.

Arachnothera longirostra Little Spider-Hunter.

Common in the foothills.

FAMILY DICAEIDAE.

Dicauem erythrorhynchos. Tickell's Flower-pecker.

Not common. A few pairs seen in May in gardens.

D. chrysorrheum. Yellow-vented Flower-pecker.

Very local. Hill jungles. The race here appears to have dark streaks on breast and not the dark line described by Smythies.

D. cruentatum. Scarlet-backed Flower-pecker.

Common.

D. trigonostigma. Orange-bellied Flower-pecker.

Three pairs in March near Ruywa.

D. concolor. Plain-coloured Flower-pecker.

Common on the coastal islands from Myebon to Ruywa. Not seen elsewhere.

FAMILY: PITTIDAE.

Pitta nipalensis. Blue-naped Pitta.

Very shy though often heard. One obtained in Mayu Range in Oct. was definitely this species.

ORDER: *PICI.*

FAMILY: PICIDAE.

Picus canus. Black-naped Green Woodpecker.

Fairly common locally.

Dryobates mahrattensis. Mahratta Woodpecker.

Fairly common.

D. macei. Fulvous-breasted Pied Woodpecker.

The race here has no white underparts. It is fairly common, especially at Akyab.

D. analis. Siamese Pied Woodpecker.

Lower hills. Scarce in Mayu Range.

Brachypternus benghalensis. Golden-backed Woodpecker.

Common.

Chrysophlegma flavinucha. Large Yellow-naped Woodpecker.

Lower hill jungles. No red on crown.

Chrysocolaptes guttacristatus. Tickell's Golden-backed Woodpecker.

Less common than the former.

Mulleripicus pulverulentus. Great Slaty Woodpecker.

Sparsely distributed in the jungle, but its distinctive cry is not uncommon.

Sasia ochracea. Rufous Piculet.

Common locally in the low ground.

Jynx torquilla. Wryneck.

One 27 Sep., one 25 Nov. Mayu Peninsula.

FAMILY: CAPITONIDAE.

Cyanops viridis. Lineated Barbet.

Common in the low ground.

C. asiatica. Blue-throated Barbet.

Common in the hills.

C. duvaucelii. Blue-eared Barbet.

Fairly common in hill jungle.

Xantholaema haemacephala. Coppersmith.

Very local and scarce except at Akyab.

ORDER : *COCCYGES*

FAMILY : CUCULIDAE.

Cuculus micropterus. Indian Cuckoo.

Common in winter. Earliest 7 Oct. Heard in April.

Hierococcyx varius. Common Hawk-Cuckoo.

Less common in winter. Heard in April.

Cacomantis merulinus. Plaintive Cuckoo.

Sparsely resident. All had lower parts russet, white.

Clamator jacobinus. Pied Crested Cuckoo.

One 25 May 1944.

C. coromandus. Red-winged Crested Cuckoo.

Fairly common in winter.

Eudynamis scolopaceus. Koel.

Scarce and local.

Rhopodytes tristis. Large Green-billed Malkoha.

Fairly common.

Centropus sinensis. Crow Pheasant.

Common.

ORDER : *PSITTACI.*

FAMILY : PSITTACIDAE.

Psittacula eupatria. Large Parakeet.

Scarce and local.

P. krameri. Green Parakeet.

Very common.

P. cyanocephala. Blossom-headed Parakeet.

Generally scarce and locally migratory, but very common in Mar. and Apr. at Ruywa.

P. fasciatus. Orange-breasted Parakeet.

The most common after the Green Parakeet.

Loriculus vernalis. Loriquet.

Common.

ORDER : *ANISODACTYLI.*

FAMILY : CORACIADAE.

Coracias benghalensis. Roller.

One in thick jungle Oct,

Eurystomus orientalis. Broad-billed Roller.

Common in open woodland.

FAMILY : MEROPIDAE.

Merops orientalis. Green Bee-eater.

Very common.

M. superciliosus. Blue-tailed Bee-eater.

Breeds in May and June. Locally migratory. Family party in Oct. in Kalapanzin Valley. Very common at Akyab in April.

M. leschenaulti. Chestnut-headed Bee-eater.

Resident but locally migratory.

Melittophagus erythrocephalus. Bronze-capped Bee-eater.

Appears to be a winter visitor.

Bucia athertoni. Blue-bearded Bee-eater.

Scarce. Nests in May. Resident and found nesting on summit of Mayu Range at 1,850 ft. in Oct.

FAMILY : ALCEDINIDAE.

Ceryle rudis. Pied Kingfisher.

Fairly common on the tidal chaungs and estuaries.

Alcedo atthis. Common Kingfisher.

Very common.

Ramphalcyon capensis. Stork-billed Kingfisher.

Scarce and confined to flooded rice fields and inland pools.

R. amauroptera. Brown-winged Kingfisher.

Locally distributed in tidal chaungs and swamps Not north of Dalet Chaung, and never noted at fresh water.

Halcyon smyrnensis. White-breasted Kingfisher.

Very common.

H. chloris. White-collared Kingfisher.

Common in tidal chaungs.

H. pileata. Black-capped Kingfisher.

Common in tidal chaungs.

FAMILY : BUCEROTIDAE.

Dichoceros bicornis. Great Hornbill.

Fairly common.

Anthracoceros coronatus. Pied Hornbill.

Rather rare.

FAMILY : UPUPIDAE.

Upupa epops. Indian Hoopoe.

Fairly common on passage and in winter. Absent in the monsoon.

ORDER: *MACROCHIRES.*

FAMILY: MICROPODIDAE.

Micropus affinis. Indian Swift.

Fairly common in winter.

Cypsiurus parvus batassiensis. Eastern Palm Swift.

Fairly common in winter.

Chaetura gigantea. Brown-throated Spinetail.

Flocks in thick jungle on Mayu Range.

FAMILY: CAPRIMULGIDAE.

Caprimulgus asiaticus. Indian Nightjar.

Uncommon. I have only heard it in April and early May when it utters a 'Tuk-tuk-tuk-tuk-chirrh!'

C. macrurus. Horsfield's Nightjar.

Its monotonous 'Chunk-chunk' is a very common sound Mar-May. Resident.

Lyncornis macrotis. Great-eared Nightjar.

One pair observed at dusk for several evenings in Mar. at Ruywa, looking rather like harriers, and uttering a call on the wing like 'Pee-wheeoo-wheeoo-wheeoo' repeated a variable number of times, followed by a protracted quavering whistle ending in a cadence. This was varied by a repetition of 'Hee-ho-hee-ho-hee-ho,' the 'ho' being a semitone lower than the 'hee.' Also heard at Myebon in Feb.

ORDER: *STRIGES.*

FAMILY: STRIGIDAE.

Strix ocellatum. Mottled Wood Owl.

Common.

Bubo ketupa. Brown Fish Owl.

Sparsely distributed, but not uncommon.

B. coromandus. Dusky Eagle Owl.

Often heard and seen sitting on the tracks at night.

Otus sunia. Burmese Scops Owl.

'Tonk tonk ka-tonk' is the commonest owl sound in Arakan.

O. bakkamoena. Collared Scops Owl.

Appears scarce and local. Nests in Apr. Utters a dismal 'whoo' at intervals.

O. spilocephalus. Eastern Spotted Scops Owl.

Fairly common. Utters a double whistle which is usually answered after an interval.

Athene brama. Spotted Owlet.

Common in the low ground.

Glaucidium radiatum. Jungle Owlet.

Fairly common in the jungles and high open forest.

ORDER: *ACCIPITRES.*

FAMILY: PANDIONIDAE.

Pandion haliaetus. Osprey.

A straggler in small numbers singly, in winter, to River Nat. Earliest 27 August.

FAMILY: VULTURIDAE.

Gyps indicus. Long-billed Vulture.

Very common.

Pseudogyps bengalensis. White-backed Vulture.

Scarce and appears migratory. It is absent May to Oct.

Sarcogyps calvus. King Vulture.

Common.

FAMILY: FALCONIDAE.

Aquila clanga. Greater Spotted Eagle.

Several observed in winter. Very tame and often allowed an approach to 10-15 yds.

Circaëtus ferox. Short-toed Eagle.

One obtained Myebon in Jan.

Spilornis cheela. Crested Serpent Eagle.

Common.

Haliaëtus leucoryphus. Pallas's Fishing Eagle.

Local and uncommon.

H. leucogaster. White-bellied Sea Eagle.

Common.

Ichthyophaga ichthyaëtus. Large Grey-headed Fishing Eagle.

Occasionally seen in winter.

Haliastur indus. Brahminy Kite.

Common.

Milvus migrans govinda. Pariah Kite.

Common but very few remain in the monsoon.

Elanus caeruleus. Black-winged Kite.

Very tame. Hovers like a kestrel. Winter visitor to Akyab.

Circus macrourus. Pale Harrier.

Common winter visitor. Arrives Nov.

C. melanoleucus. Pied Harrier.

Arives 1 Oct. Fairly common in the coastal plain and islands,

C. aeruginosus. Marsh Harrier.

Common winter visitor.

Astur badius. Shikra.
Common.

Falco peregrinus. Peregrine Falcon.
Winter visitor in small numbers. Latest 4 Apr.

Falco severus. Hobby.
Winter straggler. Two observed.

F. tinnunculus. Kestrel.
Winter visitor in some numbers to Mayu Valley. Scarce elsewhere.

ORDER : *COLUMBAE.*

FAMILY : COLUMBIDAE.

Crocopus phoenicopterus. Common Green Pigeon.
Common in flocks.

Treron pompadora. Ashy-headed Green Pigeon.
Common in the Yomas. A few shot at Ruywa.

T. bicincta. Orange-breasted Green Pigeon.
Common in flocks. The most common of all.

T. curvirostra. Thick-billed Green Pigeon.
Scarce.

Ducula aenea. Green Imperial Pigeon.
Usually seen in pairs. Fairly common.

Chalcophaps indica. Emerald Dove.
Common in the shadiest jungle.

Columba livia. Blue Rock Pigeon.
Rather scarce and local.

Alsocomus puniceus. Purple Woodpigeon.
One 17 Nov. and one 5 Dec. in thick tree jungle. Very shy.

Streptopelia risoria. Ring Dove.
Appears very scarce and local. Absent in the monsoon. One shot at Ruywa in Mar. A few seen at Maungdaw in Feb.

S. orientalis. Rufus Turtle Dove.
Scarce and local. A few shot at Akyab in Jan.

S. chinensis. Spotted Dove.
Very common.

Oenopopelia tranquebarica. Red Turtle Dove.
Common locally. Often in large flocks till May. Absent in the monsoon.

ORDER: *GALLINAE.*

FAMILY: PHASIANIDAE.

Gallus gallus. Red Jungle Fowl.
Common everywhere.

Gennaeus horsfieldi. Black-breasted Khalij.
Fairly common even at sea level.

Arborophila rufogularis. Arakan Hill Partridge.
A few were reported in the lower Yomas.

Excalfactoria chinensis. Blue-breasted Quail.
Common singly.

ORDER: *GRALLAE.*

FAMILY: RALLIDAE.

Amaurornis akool. Brown Crake.
Fairly common.

A. fuscus. Ruddy Crake.
Common.

A. phoenicurus. White-breasted Waterhen.
Common.

Gallinula chloropus. Waterhen.
Very local.

Gallicrex cinerea. Water Cock.
Scarce and very shy.

Porphyrio poliocephalus. Purple Coot.
Two or three at Royal Lake Akyab in winter.

FAMILY: GRUIDAE.

Grus grus. Common Crane.
Two 4 Nov. Three 26 Mar.

ORDER: *LIMICOLAE.*

FAMILY: GLAREOLIDAE.

Glareola pratincola. Large Indian Pratincole.
Flock 27 Oct. Common and locally migrant. Breeds early among the dunes in Mar. and Apr. on Ramree and at Akyab.

FAMILY: JACANIDAE.

Metopidius indicus. Bronze-winged Jacana.
Common in suitable spots.

Hydrophasianus chirurgus. Pheasant-tailed Jacana.
Very scarce and local.

FAMILY : ROSTRATULIDAE.

Rostratula benghalensis. Painted Snipe.

Very local. Resident.

FAMILY : BURHINIDAE.

Burhinus oedicnemus. Stone Curlew.

Ramree and Akyab in the dry west coast scrub. Rare and absent in the monsoon.

FAMILY : CHARADRIIDAE.

Arenaria interpres. Turnstone.

Large flocks on the coast on passage. Winter visitor to Ramree.

Squatarola squatarola. Grey Plover.

Scarce winter visitor. A pair in breeding plumage at Ramree 30 Apr.

Haematopus ostralegus. Oystercatcher.

A few each winter Akyab, St. Martin's Island, Ramree.

Charadrius alexandrinus. Kentish Plover.

Scarce. One or two flocks which arrive in Nov. and leave in Mar. Latest 4 Apr.

C. dubius. Little Ringed Plover.

Common.

C. mongolus. Lesser Sand Plover.

Very common on the coast and on the mud flats in winter.

C. leschenaultii. Large Sand Plover.

Common winter visitor.

Pluvialis dominica. Golden Plover.

Very common winter visitor. Starts to arrive 25 Aug. Leaves in Apr. Latest 8 May.

Hoplopterus duvaucellii. Indian Spur-winged Plover.

An odd pair or single bird usually seen where there are sand banks on the river.

Lobivanellus indicus. Red-wattled Lapwing.

Common.

Microsarcops cinereus. Grey-headed Lapwing.

Small parties late Oct. Winter visitor till Apr.

Numenius arquata. Curlew.

Common winter visitor. Arrives Sep. Leaves as late as May.

N. phoeopus. Whimbrel.

Common. Arrives later than the last, and leaves earlier.

Limosa limosa. Black-tailed Godwit.

Several shot last week in Apr, feeding on paddy at Akyab,

Terekia cinereus. Terek Sandpiper.

Common. Flocks in Apr. on the coast. Most of those shot in Jan.-Apr. had drab legs, but some had orange.

Tringa ochropus. Green Sandpiper.

Common. An early winter arrival.

T. stagnatilis. Marsh Sandpiper.

Common winter visitor.

T. hypoleucus. Common Sandpiper.

Very common in winter. Only absent from May to Aug.

T. glareola. Wood Sandpiper.

Very common in winter, and numbers pass through up to early May.

T. totanus. Redshank.

Common. An early winter arrival in small flocks. Stays into May.

T. erythropus. Spotted Redshank.

One 15 January. One 12 March on the coast.

T. nebularia. Greenshank.

Common singly and in pairs. An early winter arrival.

Erolia minuta. Little Stint.

Common. A late winter arrival, not being seen before November. Leaves in late April and early May.

E. temminckii. Temminck's Stint.

One 15 November.

Calidris tenuirostris. Eastern Knot.

Scarce winter visitor to the coast.

Scolopax rusticola. Woodcock.

Three together on 16 March on Ramree.

Capella gallinago. Common Snipe.

Common winter visitor, but practically none are shot before 1 November or after 1 April. In October out of 54 shot 48 were *stenura* and only 6 *gallinago*. In November out of 51 shot 48 were *gallinago* and 3 *stenura*.

C. stenura. Pintail Snipe.

Very common. An early winter arrival, appearing in small numbers about 15 August and gradually increasing till November. Stragglers still seen 15 May.

ORDER: *GAVIAE*.

FAMILY: LARIDAE.

Larus ichthyaetus. Great Black-headed Gull.

Often an odd one about the River Naf in winter. 20 seen near Foul Point in January. Small parties seen near Ramree and Baronga Island from time to time.

L. brunnelcephalus. Brown-headed Gull.

Very common winter visitor but a late arrival. November to Many.

Chlidonias hybrida. Whiskered Tern.

A few on passage only.

Gelochelidon nilotica. Gull-billed Tern.

Common singly on the River Naf in winter only.

Sterna aurantia. Common River Tern.

Common, but absent September and October when presumably it is breeding.

S. bergii. Large Crested Tern.

Common. Breeds on St. Martin's Island.

S. albifrons. Little Tern.

One 10 April. One 6 December. Three 3 April.

ORDER: *STEGANOPODES.*

FAMILY: PELECANIDAE.

Pelecanus roseus. Spotted-billed Pelican.

Odd ones usually frequent the River Naf all the year round.

FAMILY PHALACROCORACIDAE.

Phalacrococorax carbo. Large Cormorant.

One shot 2 November. One 29 April. No others seen.

P. niger. Little Cormorant.

Common. Breeds in August and September.

Anhinga melanogaster. Indian Darter.

Very uncommon in spite of suitable localities.

ORDER: *HERODIONES.*

FAMILY: IBIDIDAE.

Threskiornis melanocephalus. White Ibis.

Common.

Pseudibis papillosus. Black Ibis.

Uncommon. I know of only one small nesting colony near Tumbru.

FAMILY: PLATALEIDAE.

Platalea leucorodia. Spoonbill.

Stragglers in winter only. One 5 January. One 21 Jan.

FAMILY: CICONIDAE.

Dissoura episcopus. White-necked Stork.

Common in small parties and singly.

Xenorhynchus asiaticus. Black-necked Stork.

Large flocks pass over going South in October. Stragglers remain in winter.

Leptoptilos dubius. Adjutant.

Scarce. Stragglers in winter.

L. javanicus. Lesser Adjutant.

Common in winter.

Ibis leucocephalus. Painted Stork.

Usually one or two about the River Naf and Kaladan delta in autumn and spring.

Anastomus oscitans. Open-bill Stork.

A flock of 40 going South 2 November over Maungdaw. Odd ones seen in winter.

FAMILY: ARDEIDAE.

Ardea purpurea. Purple Heron.

Common in the mangrove swamps in winter.

A. cinerea. Common Grey Heron.

Winter visitor arriving November.

A. sumatrana. Dusky Green Heron.

Fairly common in the creeks in mangrove swamps.

Egretta alba. Large Egret.

Common.

E. intermedia. Smaller Egret.

Scarce.

E. garzetta. Little Egret.

Very common.

Bubulcus ibis. Cattle Egret.

Rather scarce and local. Parties arrive about 1 October and winter, leaving in April.

Demiegretta asha. Reef Heron.

Grey phase usual but one of white variety seen. Common on the Dalet Chaung.

Ardeola grayi. Paddy Bird.

Very common.

Butorides striatus. Little Green Heron.

Haunts jungle streams in the Yoma foothills.

Nycticorax nycticorax. Night Heron.

Fairly common. Party of 20 disturbed from trees during the landing at Myebon in January. Also seen at Ruywa.

Ixobrychus sinensis. Yellow Bittern.

Very local, but resident and nests in September in reed-beds near the coast.

I. cinnamomeus. Chestnut Bittern.

Common in the coastal plain.

Dupetor flavicollis. Black Bittern.

Common in the coastal plain.

ORDER: *ANSERES.*

FAMILY: ANATIDAE.

Sarkidiornis melanotus. Nukta.

Very local. One 12 December Nhila.

Nettapus coromandelianus. Cotton Teal.

Fairly common in suitable spots.

Dendrocygna javanica. Lesser Whistling Teal.

Common in flocks of up to 40 birds.

D. fulva. Larger Whistling Teal.

Scarce. Usually seen in pairs.

Casarca ferruginea. Ruddy Sheldrake.

Fairly common winter visitor. Does not arrive till end of November.

Tadorna tadorna. Sheldrake.

One flock of 7 going South 2 November.

Anas penelope. Wigeon.

An erratic passage migrant only. Not seen 1943-44 but huge flocks seen flying North over Dalet Chaung in first half February 1945.

A. crecca. Common Teal.

Common November to April. First arrivals 10 October.

A. querquedula. Garganey.

Rather scarce winter visitor with Common Teal.

A. acuta. Pintail.

Enormous flocks arrive in December and leave early March. They frequent inaccessible mangrove swamps by day, and feed in the shallow weedy fresh water pools at night. Stragglers arrive from mid-October.

A. clypeata. Shoveller.

Winter visitor in small numbers.

Nyroca nyroca. White-eye.

N. baeri. Bayer's Pochard.

A fair number pass through on passage in November and December, and again in February and March. Those shot had dark brown head with a greenish sheen (*baeri*), but I have reports of the typical race too.

ORDER: *PYGOPODES.*

FAMILY PODICIPIDAE.

Podiceps ruficollis. Little Grebe.

Very common on the scanty fresh water pools along the coastal belt.

CIRCUMVENTING THE MAHSEER AND OTHER SPORTING FISH IN INDIA AND BURMA.

BY

A. St. J. Macdonald.

(*With* 16 *text-figures*)

Part X.

(*Continued from page* 507 *of volume* 45).

Dont's and Do's about Rods (1). Fast Joints (2). Rods when out of use (3). Reels (4). Line Drier (5). Keeping swivels and split rings (6). Keeping large hooks (7). Killin wire (8). Gut (9). Wire for Mounts (10). Spoons made from old pots and pans (11). How to prepare atta or dough (12). Dressing lines with tallow (13). Dressing sea lines (14). Keeping dressed lines (15). Treating tacky lines (16). Rod and tackle varnish (17). Cobblers' wax (18). Steadying a boat. (19). Releasing hook hold in rapid water (20). How to weigh Giant Fish (21). Weighing fish with two or more scales (22). Calculating the weights of fish (23). Picking dead bait (24). Catching live bait (25). Determining the age of fish (26). Spikes for boots (27). Leeches and ticks (28). Maps (29). Rod cases (30). Clearing drinking water (31). Trophies of fish (32). Catching frogs for bait (33). Biting flies and how to evade them (34). Soldering Traces (35). Marking fish (36). Poaching (37). Butterflies (38). To soften butterfly's wings (39). Fish displaying temper (40). Record Mahseer (41). Thermometer (42). Photography (43). Formalin (44). Borax (45). Tackle Boxes (46) Fishing stools (47). Best Books on Fishing and Sport in India (48). Newman & Co. Calcutta (49). Sealing Wax (50). Enamel Paint (51). Packing and carriage of fish (52). Protecting flies from the ravages of insects (53). Dying Gut (54). Manufacture of Silk Worm gut (55). Knots for tying Gut, Flies, Hooks and Lines (56). Nylon for Casts (57). Garters (58). Ankle Puttees (59). Sore Toes and Feet (60). Sun Burn (61). Glare Glasses (62). Topee (63). Jacket (64). Tackle Outfit (65). To Skin and Preserve a Mahseer (66). Medical (67). Medicine (68). Wounds (69). Foul Hook (70). Bleeding (71). Blisters (72). Boils (73). Stings. Scorpion Stings (74). Septic Wounds from Tiger and Panther (75). Fever (76). Drowning (77). Addendum to Chapter 'Scraps from my note book' (78). Hardy's gut, wire, hooks etc.

1. *Don'ts and Do's about Rods.*—Don't put a rod away in a damp cover, or tops in damp cases. Don't use vaseline or oil on rod ferrules; tallow, raw mutton fat, or soap are the best lubricants. Don't tie rod cover tapes tightly when putting a rod away for any length of time. Don't hold the wood, or cane when putting a rod together; grip the metal ferrules in turning the rod joints or when pulling them apart.

Get your rod overhauled at the end of a season, or coat it over with varnish yourself; it will give you endless service if you do.

2. *Fast joints.*—If, as so often happens, ferrules get stuck a good tip in the first instance is to get two pieces of rubber (the inner tube of a car or motor cycle cut up does excellently), and wrap them around the joints, this will give you a good purchase, and will generally work the deed. Should this not prove successful, then heat the ferrule with a candle flame (BUT WELL AWAY

FROM THE LASHING), until it is too hot to touch, pour cold water over the joints when with the aid of the rubber it should come away. In case of an extremely tight joint a small pair of gas pliers will grip one socket without damage, and so enable the most obstinate of joints to be drawn apart.

3. *Rods when out of use.*—Hang up rods when not in use on a wall free from damp, and in a room that is in constant use, your dressing room for instance, so that they can be frequently looked over. Be careful to keep the plugs in, or a 'mason wasp' will plug it for you!

4. *Reels.*—Keep nuts and screws tight while in use, and look them over daily, or better still, after each run by a fish. One small screw lost, may put the whole reel out of action for the trip, unless you have spares. It is the hardest worked item of the outfit, and one which tackle makers have much to learn about and improve. Carry spare springs, ratchets and screws.

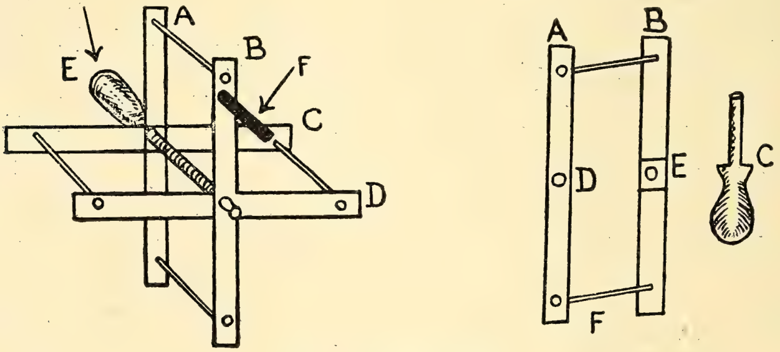

Fig. 1.—Line Drier.

5. *Line Drier.*—The four sides A. B. C. D. come apart, also the 4 stays connecting A. & B. and C. & D. When built up as in sketch, the handle and spindle E. is put through and keeps the frame together by a pin through the hole at top end of spindle, the handle is held in the left hand and the small handle F. on B. is the winding handle. Line can be cleared off a reel in a few moments. The size of the arm is 18 inches and width 6 inches. A. and B. are dove-tailed to take C. and D. inside at point of intersection. Many other forms are also offered by tackle dealers.

6. *Keeping swivels and split rings.*—I have found the best and most convenient way of keeping all small gear, like swivels, split rings, small hooks, etc., is by making use of small bottles and tins, putting them into these with oil. They keep for ever and save many a disappointment.

7. *Keeping large hooks.*—Hooks, and large or small trebles, keep best put into a tin with grease and the lid closed down. They are an expensive item and worth this additional trouble.

8. *Killin wire.*—Killin wire for traces, unless kept well oiled, will rust and many a spoon will be lost. This can be avoided by

wrapping a small strip of flannel dipped in oil around the reel of wire.

9. *Gut.*—Gut kept in flannel dipped in glycerine, will keep fresh, and will last for several seasons.

10. *Wire for Mounts.*—Cheap galvanised wire procurable in any bazar, or off a whisky case, makes excellent mounts for large spoons. (See chapter V, under 'Tackle').

11. *Spoons made from old pots and pans.*—Old cooking pots of copper, aluminium, or brass, make up into most useful spoons. These can be made up in any bazar at a quarter of the price one has to pay in tackle shops.

12. *How to prepare atta or dough.*—The best way to prepare atta, so that it sticks on one's hook in running water, is to have it first kneaded into a fairly thick mass, wrap a piece of fine cloth around it, then put into a pot and boil for a few moments, in this can be included any fancy smelly ingredients. Take out and knead until it is sticky and soft.

13. *Dressing lines with tallow.*—Plaited lines dipped in melted tallow make excellent spinning and casting lines. Coil the line into a convenient sized pot, with enough tallow to cover the line (a couple of tallow candles), when the tallow has melted, dip the line in for a couple of minutes, or until the tallow starts setting. Take the coil of line out, and with a flannel rag work a couple of yards at a time with the fingers, until it gets warm to the touch, move on to the next couple of yards and so on. This will give you excellent results, as it prevents the line swelling and does not rot the line. The more work you put in with the fingers the better is the result. Another good dressing, which also floats a line, consists of one ounce clean bees wax and one ounce (liquid measure) vegetable oil. Warm the bees wax and mix; treat line as for tallow dressing.

14. *Dressing sea lines.*—Stockholm Tar 2 ounces, methylated spirits 20 ounces, dissolve until well mixed. Coil line in a wide mouthed glass jar, pour in the mixture. Keep jar tightly closed for 48 to 60 hours. Then remove line and hang up to dry. Mixture will keep and can be used again. Sea lines, whether dressed in this way or not, should every day be washed in fresh water after use.

Synthetic resin glues, one of the discoveries of the War, form a bond of enduring strength, and is used in its different formulas to bond metal to metal or metal to wood or wood or metal to rubber, etc. It is as yet in its infancy so far as the household uses are known, but of its efficiency we may only look at the Mosquito, one of the best kites in the air today; all wood and bonded by this synthetic discovery. Here are some names to keep in mind, and watch out for their commercialization.

PHENOL-FORMALDEHYDE GLUE, Champion of all in waterproofing qualities, it is derived from phenol which is carbolic acid. It has stood six years of soaking at the Forest Products Laboratories in the U.S. and showed no more deterioration than the wood it joined. Once set no amount of heat can melt it. Other names to keep in mind are MELAMINE, UREA, RESORCINOL, and FURANE.

But the glue that is likely to prove the Angler's friend is PENACOLITE G 1131 and CASCOPHTEN Rs 216. These are made by the Pennsylvania Coal Products Co., Petrolia, and Casein Co., of America, respectively. Both these phenolic-type resins set without heat, which is of the utmost importance as it permits of use without access to special equipment found only in factories. It brings its use within the scope of the layman and amateur craftsman. This glue is a liquid that will set at room temperature—from 75 degrees F. upwards after the correct catalyst is added. It is claimed to be far superior to cold-setting UREA resins that have been in wide usage for several years. Not only is it more waterproof but it requires less critical technique in handling. It remains immune to heat, humidity or wetting (a consideration in the varied Indian climate).

CYCLEWELD made by Chrysler Motors and PLIOBOND made by Goodyear Tyre and Rubber Co. are two of the better known compounds used for bonding rubber and wood or metal.

REANITE, METLBOND, and REDUX are other adhesives of that type. Synthetic resin glues are turned out as powders, liquids, emulsions, and films. Cold-setting resin powder of the UREA type is sold across the counter and available in hardware and paint stores. It is used by mixing with water.

Cold-setting phenolic liquid is expected to be offered to the general public in small packages shortly in America.

There must be the equivalent in as many makes in England or Britain but I have no details. Rod makers of repute will be closely interested, and quick to take advantage of this new discovery.

15. *Keeping dressed lines.*—An aluminium cigar-drier makes an excellent jar for keeping dressed lines, likely to get tacky, or in fact for any lines during the monsoon.

16. *Treating tacky lines.*—Most waterproof lines, so excellent in the English climate, get sticky and tacky out here, in a season. This can in most cases be cured in 'Lime Water' (sold by all chemists).

Put the lime water into a wide bowl or cooking pot, then put the tacky line in, coil by coil, so that it does not adhere, and prevent the liquid getting to parts on the surface. Allow it to soak in this over night (it does not damage the line), take the line out, remove as much liquid from the line, as you can, and hang out in a shady spot to dry. It is a good thing when dry to rub the line over with Ceroline or any animal fat. This should restore the line to its original texture.

17. *Rod and tackle varnish.*—Shellac and spirits of wine make an excellent varnish which dries soon after use. Shellac can be purchased in flake form in most bazars. Put flakes into a bottle and add spirits to give the required thickness. It melts in a couple of hours and no further treatment is necessary. Turpentine varnishes are also excellent, but take longer to dry. Cutex nail polish also makes a good varnish.

18. *Cobbler's wax.*—A mixture of equal parts of bees wax, lard and turpentine, make an excellent cobbler's wax.

19. *Steadying a boat.*—A good tip when only a light boat is obtainable, is to tie two or more large bamboos on either side along the whole length of the boat, they have a most steadying effect and prevent the boat rolling or taking in water while shooting a rapid. This is practised by the Shans and Kachins with good results in the upper waters of the Irrawaddy.

20. *Releasing hook hold in rapid water.*—The spoon is often caught up in snags and rocks in a rapid where a boat cannot go. A good dodge is to attach the line to a piece of bamboo or small forked branch by a running loop. Get above the spot where you are hung up, and release the bamboo, so that it will pass over where you are snagged. Give plenty of line, and as often as not, when the bamboo passes over or gets below where your hook is fast, it will come away. An excellent tackle release—vouched for by a correspondent who has used it a great deal, is a three-quarter inch piece fairly hard wood four inches in diameter, with a bevelled hole through the centre, this hole big enough to allow largest sinker used to pass through. Outside edge of disc should be rounded and the wood be sand papered and painted white. The disc is slipped on the line by means of a V slit cut to centre hole and stopped by a smoothly and accurately fitting wedge. The disc on reaching the water works its way to where the bait is fast and the action of the water releases the hook. It 'works' in most cases; but not, of course, if the hook is in a 'snag'. Cost is nil, it is nearly always recovered as when a break away has to be made it floats and can be chased and collected by an attendant. It is worth its weight in gold as a saver of tackle.

21. *How to weigh giant fish.*—Cut two bamboos of equal length A. and B., fix them in the ground so that they give you a clearance of a foot at least, above the length of your fish. Slot these bamboos to take a third across C. Now mark off the centre of the bamboo C, and from here suspend your fish. With spring balance hook on one end, lift bamboo C and as soon as it moves take your reading.

This doubled will give you the weight of your fish. I have tested this method and found it works out exact with weighed fish. It would only be used on fish with greater weight than your scale registers.

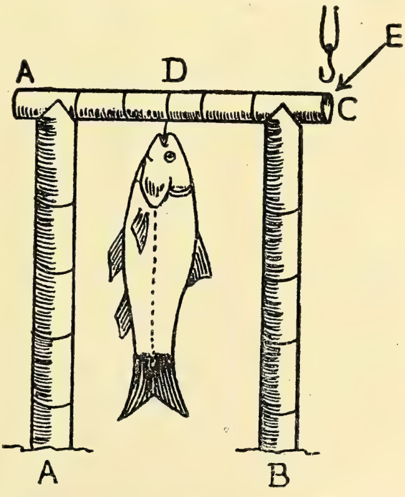

Fig. 2.—Weighing giant fish.

22. *Weighing fish with two or more scales.*—The following is from the *Rod in India* and is produced here for information.

> 'When I bought my fishing tackle, I thought a spring balance weighing up to 32 lbs. was big enough for any man. But one fine day I had the misfortune to catch a mahseer well over that weight, and, of course I was particularly anxious to know its exact weight. I had in camp two spring balances weighing respectively up to 28 and 32 lbs. I passed a stout cord through the rings of the two, and suspended them from above. Then a cord attached to the fish and passed over the two hooks suspended the fish simultaneously from them both. Reading off the weight indicated by the two instruments and adding them together, the result was the weight of the fish, 46 lbs. If neither of the springs is pulled down beyond its power of springing, the total is bound to be accurate. I have tested it.'

23. *Calculating the weights of fish.*—By the common formula laid down in "The Angler's Hand Book", I have not found this work out consistently on the large fish. I have reproduced here four examples, in which only one is really anywhere near correct, still if no other means are available, it gives the approximate weight.

Examples.

$$\frac{\text{Length and one-third length} \times \text{Girth squared in inches}}{1000} = \text{weight}$$

of fish.

Rivett Carnac's record mahseer of 119 lbs was 64 inches in length and 42 inches in girth. Example:—

$$\frac{(64 + 21) \times 42^2}{1000} = \frac{149940}{1000} = 149.$$ 30 lbs. in excess.

My three best fish, all healthy and game, work out as follows:— Weight 75 lbs. Length 50 inches, girth 34 inches, according to formula works out to 72 lbs. Three pounds short of actual.

Weight 50 lbs. Length 56½ inches, girth 28 inches, works out to 58 lbs. 8 pounds in excess of actual.

Weight 44 lbs. Length 52 inches, girth 26½ inches, works out to 48 lbs. 4 pounds in excess of actual. It is stated to me by a correspondent that such a formula is accurate to a pound if the measurement of length is to *fork* of the tail and one quarter and not one-third is taken e.g. $\frac{L + \frac{1}{4} L \times G^2}{1000}$ is a good formula. Brother Anglers may try it out for themselves.

24. *Pickling dead bait.*—Before inserting in the formalin solution, cut off the fins, all except the anal fin. When the fish begin to stiffen in the solution, the required sideways bend should be given to the tail: some to right: some to left. This bend cannot be given after the fish are stiff. Only actual practice will teach the angler the correct strength of formalin to use. If too strong the fish will be white; the weakest solution compatible with preservation will give the best results. The following two recipes for preserving minnows as spinning bait, are taken from the *Fishing Gazette,* with acknowledgements:—

> 1. 'Kill the minnows in a solution of formalin and water. In 24 hours or thereabouts, wash the minnow under the tap, in order to take as much of the smell of formalin out as possible, then place them in a wide-mouthed jar. Dissolve sugar and water and pour it over the minnows, leave the lot exposed to the air; in a week or so smell the minnows to see if the formalin taint has disappeared; sugar and water in which they are may be kept for months.'

2. 'Minnows preserved for use as spinning bait should be free from the smell of preservative. Salted specimens are good, but not so well suited to the purpose as those prepared by the following method. Formalin as sold to the public is acid and for our purpose should be non-acid. The necessary change can be effected by adding a pinch of baking powder to an oz. of formalin. Keep the minnows alive for 48 hours in a basin of water to which has been added a teaspoon of common salt; this will reduce the size of their bellies. Kill by a flick on head with finger nail and place in a bottle to be tightly closed (Prune jar excellent) in which is: distilled water 99 parts, non-acid formalin one part. After a few days change the solution. The fish will keep for a long period. When required for use remove any smell of formalin there may be, by washing in salt water; and if possible, to make quite certain, mix the prepared minnows with fresh ones and all smell will disappear. If the baits are large, they can have a bend given them tc assist spinning. This bend they will retain.'

About a dessert spoon full of formalin to a pint of water is enough for small baits. The more formalin, the more difficult to get rid of the smell; so use it as weak as suffices to preserve the minnows in the first instance. The sugar solution should be weak, merely a thickish fluid, the formalin makes the minnows tough and if too strong, turns the eyes white, and takes the colour out of the fish. If the sugar solution is too strong, it is apt to shrivel the bait. The minnows are not ready to transfer to the sugar and water until they are firm to the feel, and rubbery to the touch. Sometimes a scum comes on to the top of the sugar solution, but this does not matter and is caused by not completely covering the fish with the solution. When required for use, a few fish can be taken out, washed, and carried in a tin box, surplus minnows being returned to the solution at the end of the day.

Several fish can be killed on the same minnow. The formalin solution should be 2 per cent or one part formalin to 49 parts water.

There are other ways too of pickling dead bait, but I think the latter of these two is the simplest and the most convenient as well as the best.

Taint of preservative of any kind will be removed from prepared baits by smearing them with Pilchard oil (doubtless Sardine oil equally effective)."

—*Fishing Gazette* 6-8-1921.

Another method of preserving fish, is to place the *chilwa* on a board with the tails curved by means of pins. These are then painted with a strong solution of formalin (3 teaspoons formalin to 2 tablespoons water). After ten minutes the baits are absolutely set, and are then placed in a jar containing two tablespoons of formalin per pint of water. In three days the baits become rubbery and hard. Once the baits have become saturated with formalin, they can be carried dry during a fishing trip.

25. *Catching live bait.*—In a running stream, if you are unable to catch small fish for bait, a useful tip is to dig a small channel a few inches across and a couple of inches deep, and connect it a few yards above into a small pool where fish can be seen. In this run put some atta, tied up in a cloth so that it runs down mixed with the water. This should be done at night. Early next morning, the channel should be closed at both ends; you will be unlucky if you are not provided with bait for that day. It is not always possible to dig a channel. If there is a fall, erect a small platform with cloth or fine net and arrange your atta in the same

way, so that it washes through to the pool below. The small fish will jump to get up to better feeding, and get caught on the platform. It should be erected low enough to catch jumping fish, but should not hold water, or they will jump out again. This method can also be applied from a boat, by erecting your trap over one side, and holding a lantern on the edge. Fish have a strong curiosity for lights. If no suitable small stream is near by, and there are only large pools, get a basket and cover it over with a fine cloth, lower the basket into the water until it is covered by about ten inches of water, in it should be put rice atta or any other suitable bait. Make a few holes in the cloth so that the bait can run out and fish go in. Fish find their way in and get trapped.

26. *Determining the age of fish.* (From the *Scientific American*):

> 'The age of a fish can be determined with accuracy by inspection of the otoliths or bony concretions, which are found in the auditory apparatus. The otoliths increase in size during the entire life of a fish, each year adding two layers, a light coloured one formed in summer and a dark one formed in autumn and winter. The alternate layers are sharply contrasted and very distinct, so there is no difficulty in counting them. The number of pairs of layers is equal to the number of years a fish has lived.'

27. *Spikes for boots.*—Whiteaway Laidlaw & Co., Calcutta, sell excellent screws for boots called 'Plus Four Screws'. Rowe & Co., Rangoon, also stock excellent studs sold with a punch and screwing device complete. A very handy and cheap addition to one's fishing kit.

28. *Leeches and ticks.*—Never pull off a tick or leech, one is seldom without matches and an attendant. Burn a leech with the flame of a match, by holding its body away and applying the flame, it will at once leave go. For a tick, too small to burn, heat a pin point and touch it with it. Here are one or two suggestions as a precautionary measure against these pests. When there is no wading to be done, a strong infusion of tobacco leaves with addition of salt is effective, and does equally well for master and his bare legged followers. Wear two pairs of stockings woollen below and a pair of cotton stockings soaked in the mixture above. The wearing of a high spat well damped in kerosine and worn over woollen and cotton stockings, as above, will keep off leeches, whether you wade in water or not. Kerosine must not get to the skin or blistering will result.

A sure preventative against tick bites is.—Cocoanut oil 90 parts, eucalyptus oil 10 parts. Anoint the whole body neck to toe, before dressing. Ticks may crawl, but they won't bite. (You can decide for yourself which is preferable tick bite or this oil bath !)

29. *Maps.*—Whenever undertaking a trip into unknown country, a large scale map of the locality is of great value. One is able to mark in good spots, letter runs and rapids, which serve with notes for any future trip. These are obtainable from the Government Map Depot, Wood Street, Calcutta, at a very nominal charge.

30. *Rod cases.*—A cheap and most serviceable rod case can be made up from the large hollow bamboos that are common in Burma and India. Cut a section from one of these, long enough to take

a rod leaving a knot intact at one end. From the other end, burn or cut out the knots, and have a leather cup fitted with strap and buckle. If this is not possible cut the length of bamboo in half,

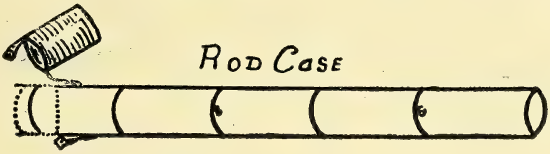

Fig. 3.—Rod Case.

cut out the knots and bind together again, with the same fitting as in the first case. See diagram.

31. *Clearing drinking water.*—If one is dependent on the river for drinking water, and it should come down in spate, a pinch of alum put into a bucket of discoloured water will soon clear it. It is a handy commodity to have by one, being an excellent preservative for skins. Or you can dig a hole some feet away from water's edge and obtain reasonably filtered water.

All drinking water should be boiled: but on occasions when this is not possible one drop of tincture of iodine of seven per cent strength to a quart of water: and the water then well shaken: will, in 20 or 30 minutes, kill all the harmful bacteria that are likely to be there. The amount of iodine added is too slight to even taste.

32. *Trophies of fish.*—The gill plates and teeth of large mahseer make good souvenirs. They can be made up into a quaint mascot for a car, or mounted on a shield. Scales make useful luggage tickets, and menu cards, but are a temptation to the souvenir hunter.

33. *Catching frogs for bait.*—Frogs are curious little creatures and if one dangles a piece of rag tied on a hook above them they will surely jump to catch it, in this way you can fill a pot, should you want them for bait. Most predatory fish relish frogs. The green and yellow, or brown, are the best. Do not confuse frogs with toads.

34. *Biting flies and how to evade them.*—Citronella or Flit, keeps off the many varieties of biting flies met with in the densely forested areas, particularly in Burma and Assam. Smeared over the knees, hands, and neck prevents much discomfort and misery. These liquids are evanescent. Citronella mixed into white vaseline (as done by the Forest Dept.) forms an unguent which has lasting effect.

35. *Soldering Traces.*—'Tinol' is an excellent soldering paste for securing the ends of wire. A little applied to the end of wire and passed through a lighted match sets it firmly, causing no damage to the wire. The 'Britinol soldering outfit' or one of similar efficiency, is essential to an Angler.

36. *Marking fish.*—This is unfortunately little practised out here, because of the size of rivers and a shifting community. Where ever it is possible, as in the case of fishing clubs, marking of fish should be introduced, as it gives most interesting results. A

simple method is with a small brass or copper foil plate, 1½ inches long by ½ an inch wide fixed to the dorsal fin by thin copper wire with distinguishing letters, and a note made in the fishing book at the club or fishing hut. (See diagram.)

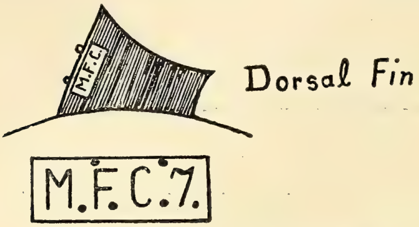

Fig. 4.—Method of marking fish.

37. *Poaching.*—The Burman is an adept at poaching. The cleverest thing I witnessed in this line was by my servant. If a jungle fowl called, he would go into the forest as near as possible to the cock, sit concealed in a bush, and utter noises like a hen scratching and feeding, he accompanied this with a most original clucking noise. Frequently the cock would come to investigate, when he would shoot it. He kept me provided in this way, though most of them were tough patriarchs. In Ceylon, jungle cock are enticed in a similar way by a handkerchief loosely held and brought together by the hands to make a 'clapping' sound, taken by the cock to be the challenge of a rival.

38. *Butterflies.*—A small net for catching butterflies, is a handy and useful addition on a fishing trip. On the odd day when the river is coloured and fishing not possible, a few hours can be well spent gathering a variety of butterflies. Small paper packets for preserving specimens can be made up from greaseproof paper; and even though not up in the scientific names, you will find lots of people who will be pleased to take your collection. Burma has some beautiful specimens, which if set and arranged in a case make a useful ornament in the home.

39. *To soften butterflies' wings.*—Take a tin of convenient size one inch deep, and fill it with saw-dust, then place a sheet of damp blotting paper soaked in a solution of water, with a few drops of Carbolic acid, this is added to prevent moulds which otherwise grow quickly. Put the dry insects into the tin and keep for six hours, or until the wings are moist enough for setting.

40. *Fish displaying temper.*—I saw a fish display what one would reasonably describe as temper. This was in a stream, in Burma, a few yards from my bungalow. I had some 200 mahseer collected from 4 pounds down to a few ounces, where I used to feed them daily under a large concrete bridge. They were protected and no fishing allowed. The stream was no more than 6 yards across and 4 or 5 feet deep and crystal clear. They made an interesting study. It was here that I saw a fish of 2½ pounds clear the hole of some 60 or 70 large fish. The trouble arose when I put in a short hand line with a fly spoon to catch a fish or two for purposes of marking. This fish broke my line and the small Mother-o-Pearl spoon could be seen distinctly hanging from the fish's mouth. Any fish that came near it was chased. The whole performance was clearly visible and most amusing.

41. *Record Mahseer.*—From *The Field* dated 11-1-1920, by Mr. Van Ingen:—

'Whilst fishing on the Cauvery last Christmas, with Mr. P. F. Bowring, D.C., Mysore, Col. J. S. Rivett Carnac and Major C. Jackson, V.C., I had the pleasure of witnessing the capture of the largest mahseer ever caught on rod and line in India. This mighty fish was caught by Col. Rivett Carnac on December 28th, 1919, and was of the following measurements, weight 119 pounds; length 64 inches; girth 42 inches; tail fin 20½ inches; circumference of mouth 26 inches. Previous to this, the record mahseer caught in India, was 104 pounds, caught in 1906 by the late Mr. C. E. Murray Aynesley, at the junction of the Hutty and Cauvery rivers in Coorg, and the largest fish (other than the mahseer was a 112 lbs. Goonch). I feel sure that many years will elapse before the Colonel's record is beaten.'

'This 119-pounder on being hooked, put up a tremendous fight, running out about 125 yards of line in her first rush (so characteristic of the mahseer), and had she kept on straight a break was inevitable, hardly 5 yards of line remaining on the reel, but fortunately for the fisherman she turned and made up stream, and the Colonel was able to recover line. After that the fish made several other big rushes, but there was line to spare. I was keeping time, and it was 25 minutes before we got a glimpse of her, and finally, when she was gaffed by Mr. Bowring and drawn ashore, the excitement was so great that I quite forgot the timing. The average for 1,600 lbs. of mahseer caught this season, works out at about 4 lbs. a minute, so the 119-pounder must have taken half an hour or more. This old hen-fish had a huge hog back, and her body almost cylindrical in shape and must have seen many monsoon floods; and, judging from the age of sacred fish in Mysore, she must have been 200 years old. Major Jackson hooked a fish immediately after this big one was landed, and in almost the same place, probably her sister. This fish ran out about 160 yards of line, and after two hours' hard work got round a snag and broke. The scale used for weighing this mahseer registered only up to 112 lbs, and we were obliged to cut the fish in two pieces and weigh both pieces separately; consequently some blood was lost in this operation, and the fish had been in the sun and wind for three hours before weighing. Yet with all this, the actual weights registered, totalled 119 lbs. I am sure had we suitable scales, the fish immediately after capture would have been 120 lbs.'

In contrast to Mr. Van Ingen's account, I reproduce Mr. Lacey's fight with a 61-pounder at Tangrot, from *The Angler's Hand Book*:—

'This last fish the biggest on record in the Tangrot Angler's book up to the present, was hooked about 9-30 A.M. He rushed all my line out, 140 yards, just as I landed from my boat, and was pulling dead on the knot.* I ran on, but fell in the mud, when my boatman Rokundin, to whom great praise is due, seized up the rod, and rushed into the water, the fish now making straight across the water for the "big rapid". Most fortunately Deputy Surgeon-General Collis' boat was following mine, and getting into it, we followed the fish down the rapid, at a frightful pace and at one time must, I believe, have passed the fish, the 140 yards of line being loose in the river, but providentially it caught in no rock, and I found the fish on when I landed below. Two or three times he had taken all the line out, and was pulling dead on the knot; but by a miracle nothing broke. The fish took to sulking, and for fully 3½ or 4 hours, I hung on to him, but could not move him. At last at about 2 P.M. he gave in, and I landed him. A female fish 4 ft 7 inches in length, and 2½ ft in girth, weight 61 lbs. Caught on a 3½ inch silver and brass spoon and treble gut trace.'

42. *Thermometer.*—A small thermometer is a very useful article to include in one's kit, as the study of the temperature of the water

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* From this remark the reader will be left with the impression that 150 yards of line is sufficient and that my estimate of the fighting powers of the large fish are grossly exaggerated. These fish are, I believe, mostly taken on paste, and have resorted to bottom feeding, living a lazy life and gone to seed, as this is certainly not characteristic of the mahseer of northern India, Assam or Burma, taken on spinning bait.

is a very big consideration. Note down what it is when fish are well on the feed, and when not. We have lots to learn about the almanac of fishes, and their feasting and fasting days.

43. *Photography.*—If developing in hot weather, when the temperature of the water is warm and likely to melt the dressing of a film, first of all wash in a solution of formalin 4%, this fixes and hardens a film and is a certain cure.

44. *Formalin.*—Formalin is the angler's friend, being useful for so many purposes. The collection of small fish as specimens, is a very simple matter and gives little trouble. Requirements: A bottle of formalin (formaldehyde) as sold by chemists; a coil of Zinc foil; a reel of thin copper wire; two wide mouthed bottles (Prune Jars); one or more empty one-pound biscuit tins.

The specimens should be washed in clean water, after making as small a cut as possible in the belly, to remove intestines, and wiped dry. Then place in a bottle containing clean boiled water (cold) 20 parts; formalin 4 parts. After a few days change to the other bottle, in which there is similar lotion. Then remove to the biscuit tin, wrapping each specimen in a piece of linen soaked in the solution, and pack after the manner of sardines. Specimens should lie straight, and therefore not be longer than the biscuit tin. Each specimen before going into the first bottle, must have attached to its tail (by passing a piece of wire through the fleshy part), a ½ inch square zinc label numbered, to correspond with entry in the note book in which are the following particulars:—Serial number, locality latitude, name of rivers, stream or lake, local name of fish, size to which said to grow, nature of stream or water, food, habits, etc., any remarks.

A copy of entries goes with each tin, which is soldered down and despatched by registered post to 'The Curator of the Bombay Natural History Society, Bombay.'

At the commencement of the collection, the strength of the solution should be watched and increased if necessary, for good preservation. The nose will test this, care should be taken to use as weak a solution as is compatible with proper preservation; for strong solution causes too great a change in colouration.

Meat painted with it will keep longer in the heat. Fish can be preserved for specimens for museums. Dead bait can be preserved for months in it; it is a very handy thing to have by one. See under (24) ante for removing formalin taint.

45. *Borax.*—Obtainable in any bazaar. In warm weather wrap your butter in a piece of muslin dipped in 2% solution of borax, and it will remain hard.

46. *Tackle Boxes.*—Allahboy Vallarjee, Multan, makes up excellent tackle boxes. They are strong and last for ever. It is the best tackle box I have seen, and costs with two trays Rs. 30/-

There is no better tackle bag than the British troop's webbed haversack, obtainable on payment from the Quarter Master's stores of any British Regiment.

47. *Fishing stools.*—The ordinary 'Mora' made from the tough grass common in India, obtainable in most towns for a few annas, adds much to one's comfort while fishing from a boat.

48. *Best Books on Fishing and Sport in India*:—

1. **'The Rod in India'** by H. S. Thomas, published 1897. Undoubtedly the most complete book ever written on Indian fishing.

2. **'Tank Angling'** by the same author, has useful information for the beginner.

3. **'The Angler's Hand Book'** by G. H. Lacey, published in 1905. Has a number of maps of good localities, and deals chiefly with the north of India.

4. **'The Angler in India or Mighty Mahseer'** by Skene Dhu, published in 1923. Has 400 pages devoted to localities all over India.

5. **'Hints to Amateurs in Tank Angling'** by P. N. Bhattacharyya. This is the best guide I know on this form of fishing.

6. **'Game Fishes of Bombay, The Deccan and Neighbouring District'** by Sir R. Spence and S. H. Prater.

Besides these books there are certain clubs that have magazines issued quarterly or annually, dealing with local areas or provinces. Chief among these are:

(a) 'The Nilghiri Fishing Association', Ootacamund, South India.
(b) 'The Dehra Dun Fishing Association', Dehra Dun, U.P.
(c) 'The C.P. Angling Association', Jubbulpore, C. P.
(d) 'The Myitkyina Fishing Club', Myitkyina, North Burma.

Other general books useful on a fishing or shikar trip:

(a) 'Identification of Indian Butterflies' by Brig. W. H. Evans.
(b) 'Identification of Poisonous Snakes' by Wall.
(c) 'The Book of Indian Birds' by Salim A. Ali.
(d) 'Popular Handbook of Indian Birds' by H. Whistler.

Big Game and Shooting books:

(a) 'Wild Animals in Central India' by Dunbar Brander.
(b) 'Big Game Shooting in the Indian Empire' by G. H. Stockley.
(c) 'A Game Book for Burma' by E. H. Peacock.

49. Newman & Co., Calcutta, in 1919 made up for me an excellent Log Book, 9½ by 8½ inches of strong paper and bound in leather. Small leather tags show different compartments, the left hand sheet ruled off in manner shown on specimens, the right hand sheet left blank for notes. Under the four headings:

Fishing. Small Game. Big Game. Pig Sticking.

50. *Sealing Wax*.—A few sticks of Sealing Wax in various colours are handy for painting spoons. These dissolved in spirits of wine make the best paint for spoons.

51. *Enamel Paint*.—Good enamel paint is available in most Indian bazaars and is sold in convenient sized tins. They cover a wide range of colours.

52. *Packing and carriage of fish*.—Directly a fish is taken out of water, it should be killed, disemboweled and cleaned (not with water), with a bundle of grass or dry cloth. The inside should then be sprinkled with charcoal and salt alternately. Oil rubbed over the inside surface is also used. In England stinging nettles are much used for packing fish, it greatly preserves the bloom and freshness.

FISHING

DATE	LOCALITY	FISH	WEIGHT	GIRTH AND LENGTH	BAIT AND TACKLE	REMARKS

NOTES

53. *Protecting flies from the ravages of insects.*—

1. Napthaline crystals efficiently protect Salmon flies from insects. Fill a small pill box with powdered crystals, then cover over with a double layer of muslin instead of the lid, and place with the flies. The crystals must be replenished every few months, as they evaporate. Flies keep better in a tin case than in an ordinary fly book.

2. Keep your flies flat between layers of silver paper, in a close shutting tin box, and they will keep for years. If the tinsel gets tarnished rub it gently with a piece of soft wood (wedged off to a point), with a little plate powder, to regain its brightness. In both instances exclusion from light and air is essential.

54. *Dyeing Gut.*—To dye gut green, boil a strip of green baize with a small piece of alum, while the liquid is still warm place the gut in it, and allow it to stand for a few hours.

To dye gut blue, heat some ink and in it soak the gut. Do not allow it to stand too long. 20 minutes is enough. It can be stained to any degree of colour, depending on the mixture. A strong decoction of tea, well boiled will stain gut; use in the same way as ink.

55. *Manufacture of Silk Worm gut.*—Messrs. S. Allcock & Co., of Redditch, England, have published an interesting article in their fishing tackle pamphlet on gut, which reads as follows:—

'This is perhaps the most curious and interesting of the many departments in the manufacture of fishing tackle. All anglers make use of silk worm gut, but large numbers are quite ignorant of its origin. In some parts of the kingdom it is called Indian weed, and looked upon as a species of grass, and any attempts to prove its being really the entrails of an insect are derisively resisted. The breaking strain of salmon gut when made into casts is as under:—

Sizes ...	1/5	2/5	3/5	4/5
Breaking strain ...	15	12	10	9 lbs.

Lake and trout casts :—

Padron	Regular	Fina	Refina	1x Drawn	3x Drawn.
8	7	5	4 lbs.	3	1 lb.

Gut is made from two small organs situated in the body of the silk worm. These organs contain the silk before it is developed or has been spun by the silk worm; great nicety is entailed in taking the worm at the proper time, otherwise the gut is useless. The worms are thrown into vinegar, and there left for some hours. This process kills the worms and solidifies the organs. These are now taken out of the worm, and pulled out as far as they will go, from end to end. These organs thus extended, being in fact 'the gut', are now left to dry. They are in this stage more or less rough and stringy, but are polished and finished off with some soap and a little soda. According to the size of the organ, so depends the thickness and length of each strand of gut. The strands are then sorted and laid out according to thickness. Gut is, therefore, nothing more than solidified silk; thick gut is doubtless made from larger worms, which are difficult to obtain, and hence the cost is much increased. 'Drawn' gut is very fine, and is made by scraping it down and drawing it through a gauge or standard.

Messrs. Hardly Brothers produce in their Anglers' Guide, some interesting facts of experiments on gut, which I reproduce:—

'Gut or gut casts cannot be tested with a view of giving a guaranteed breaking strain, but in order to give some tangible idea as to the strength of good gut, elaborate experiments have been carried out in a Science department of one of the Universities. The apparatus used measured simultaneously the strain applied and the elongation produced. These results must be taken as a general guide and not in any form of a guarantee.

The following details from an article in *The Field* are extracts from these tests :—

1. The strength of gut is surprisingly high, calculated from minimum and maximum data actually observed, breaking at 17-23 tons per square inch.

2. The strength of gut is chiefly dependent on the rate of smooth continuous loading. No comparison between the strength of specimens can be made unless the rate of loading is kept constant in all such experiments.

3. The strength increases the higher the rate of loading. Thus a test piece of 2x cast which broke at 3·4 lbs. when the rate was 8·1 lbs. in 100 seconds, broke at 5 lbs. when the rate was 8·1 lbs. in 50 seconds. The bearing of this on the sudden strain involved in striking a fish is obvious.

4. Although of no practical interest to anglers, it was found that dry gut was stronger than damp.

5. The diameter of the casts varied but slightly throughout their length; it increased slightly on damping, and was very constant.

6. The table below gives the smallest breaking stress which was observed in testing various sizes of gut. The average strength would be higher in all cases, but the tests actually made on small pieces cut from the various casts shewed that these would have broken at the loads given in column 3.

Designation of Cast.	Diameter in Inches.	Strength in Lbs.
4x	·006	1·5
2x	·009	2·7
0x	·011	3·5 (another 4·4)
7/5	·013	6·3
6/5	·015	6·6

7. As the stress was applied to the test pieces they elongated, the instrument registering an elongation of 10 per cent. per piece before breaking.'

56. *Knots for tying Gut, Flies, Hooks, and Lines.*—The variety of knots used by fishermen is numerous, and each angler has his own favourite, to which he attributes advantages over all others, so that for purposes of choice, I have listed 24 varieties in diagram, which can quite easily be followed by placing the diagram before one, and with one or two pieces of line the fancied knot can be practiced and mastered. I have mentioned my choice in Chapter V.

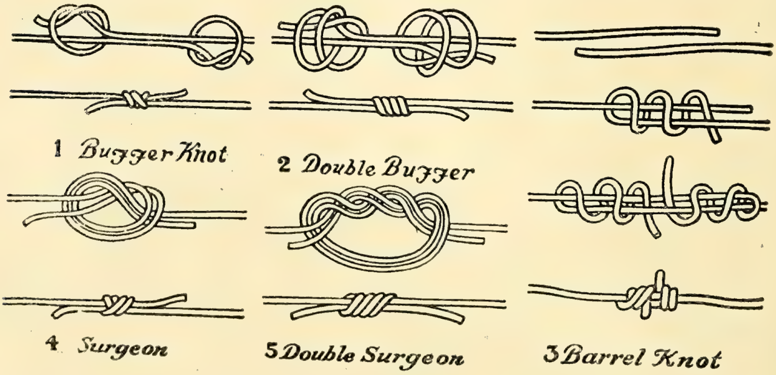


Fig. 5. To tie two strands together.

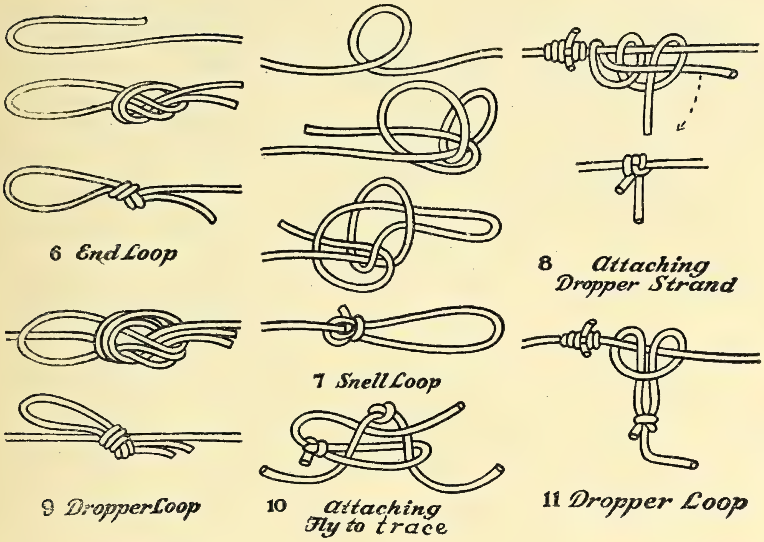

6 End Loop
7 Snell Loop
8 Attaching Dropper Strand
9 Dropper Loop
10 Attaching Fly to trace
11 Dropper Loop

Fig. 6. *To tie Loops in Gut.*

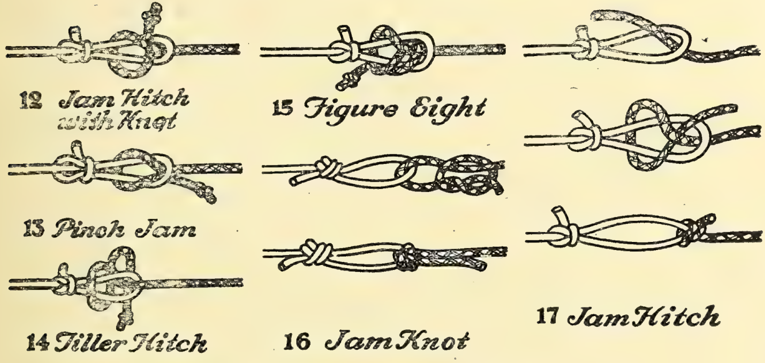

12 Jam Hitch with Knot
13 Pinch Jam
14 Tiller Hitch
15 Figure Eight
16 Jam Knot
17 Jam Hitch

Fig. 7.—*Attaching Line to Trace.*

57. Nylon for casts.

From *The Field* dated May 27, 44:—

'I think the difficulty of knotting Nylon has been grossly exaggerated. It has been made to appear a sort of voodoo rite which only a witch doctor can perform. This is not my experience at all. For trout and sea trout flies I find an ordinary Turle knot perfectly satisfactory. For salmon flies the knot made by passing the gut through the eye, over the neck of the fly and back through the eye and finishing off with a half hitch seems perfectly safe.

For joining two lengths the double fisherman's knot has served me faithfully. I recently received some Nylon from America, and the firm which made it, one of the Pioneers of Nylon for lines and casts, recommend the single fisherman's knot for joining two lengths. Anyway after the war Nylon will be obtainable in long lengths. I have some 10-yard lengths now, and so the knotting problem will be less acute—if it ever really was.'

58. *Garters.*—I find I can never keep my stockings up for long, while wading about in rapids. I have tried the ordinary woollen gart-

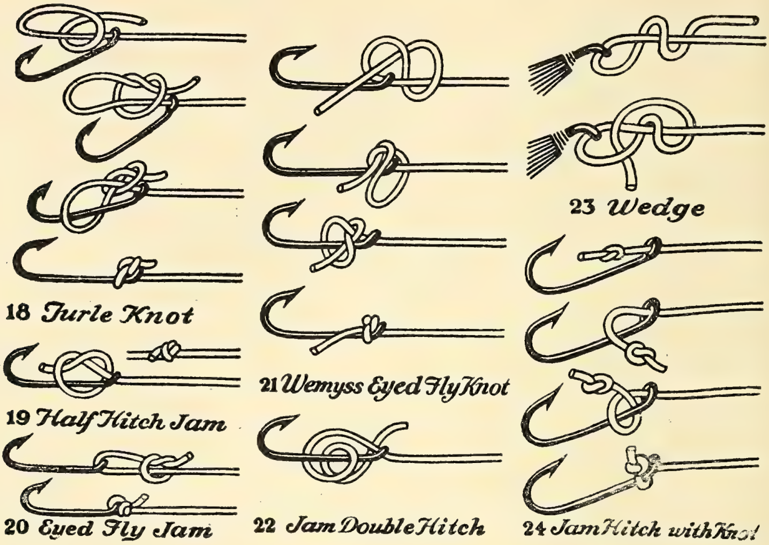


Fig. 8.—*Attaching Gut to Flies or Hooks.*

ers, and elastic, and have now resorted to cutting strips of rubber cross section, through an old inner tube of a tyre, and find they work excellently.

59. *Ankle Puttees.*—Puttees tied over the boots will save many a sore patch on the foot, as however careful one is in tying a boot, shingle, coarse sand and gravel will find its way in through the top.

60. *Sore Toes and Feet.*—With constant wading the feet are sometimes apt to get very sore between the toes, and a form of eczema, rather similar to 'Bengal Rot' attacks the skin of these parts. Grease freely applied will save the feet to a certain extent. Frank Ross & Co., Chemists, Calcutta, make a special ointment for the infection, which I thoroughly recommend. I have found the water so bad in some rivers, that both the boatmen and I were hardly able to walk. The local fishermen told me that if the water is at all discoloured, from storms in April/May, they rub mustard oil over their legs and feet before wading. This curious condition is apparently caused by rotten vegetation or toxic salts being washed into the river. Oxide of zinc powder will disinfect and dry up the sore places between the toes.

61. *Sun Burn.*—Vaseline rubbed over the face, hands and knees, will save peeling and blisters, and much discomfort, if one is not accustomed to the sun. It sounds a messy job, but is really not as uncomfortable as it sounds.

62. *Glare Glasses.*—Sun glasses are very necessary, as one is facing the sun most of the morning and evening (that is if fishing correctly) and the glare off the broken water in a rapid, is intensified, and most trying. Care should be taken to see they are strictly *neutral.* The recently invented 'Polaroid' glasses enable one to see under the surface of the water.

63. *Topee.*—A topee of the Pigsticker type, with a large brim and worn back to front, protects your face. The usual small ventilation holes can be enlarged by insertion of cut revolver cartridge cases, much to the cooling of one's skull.

64. *Jacket.*—A sun proof or khaki drill sleeveless jacket, with lots of pockets that button, is handy for carrying small pliers, scissors, a small tin with fly spoons, swivels, split rings, etc. The buttoned pocket will save losses one can ill afford, as tosses are inevitable while wading.

65. *Tackle Outfit.*—Do not try to buy a complete outfit of tackle, all at once, it hits the 'exchequer' rather hard. Get the few necessities, and add to them each year. A good way of doing this, is to give yourself a birthday or X'mas present, or better still give your wife a nice rod or reel, when her birthday comes along ! !

66. *To Skin and Preserve a Mahseer.*—With acknowledgements to Van Ingen and Van Ingen Taxidermists, Mysore:—

'Lay the fish on a board, and make an incision—not down the belly—but along the centre of the side from gill to tail, the heavy bone or scapular arch under the gill covers being cut through at this point, the object being to remove the body from the skin with as little disturbance of the scales as possible.

When skinning, leave plenty of flesh attached to the skin. This can be removed later and do not lift or pull the skin in any way as it is apt to displace the scales.

When the back is reached, place the point of the knife against the base of the fins, and strike the back of the knife smartly with a block of wood, and the obstruction can in this manner be cut through easily.

The body should be disjointed near the head and tail and removed in pieces. The gills, tongue, eyes and all the bones, etc., inside the head be cut clean away. The flesh on the cheeks is covered with very delicate skin. All this flesh should be carefully removed, but from inside the head, so that this skin is not injured.

The head, when finished, should be just a shell. The lips, which are very thick, must have incisions made inside to allow the preservative to get well in. While cleaning the head, particular care should be taken not to bend it back over the skin where it joins the head which is quite narrow and this is where the scales always come away.

After cleaning the skin thoroughly of all flesh and fat, paint the inside with arsenical soap and fill lightly with straw, and small sticks arranged lengthways which will prevent the head being bent over accidentally, and draw the edges together with a few stitches. The skin will then dry in some shape. The fins need not be spread out to dry. A little arsenical soap may be applied to these also. Never use salt or alum. Arsenical soap is the only suitable preservative for fish. Save any of the scales which may happen to work loose.'

67. *Medical.*—Fishermen journey to wild places, far from medical assistance, so should have some knowledge of medicines and first aid. The local jungle people will call for it, and help given will be greatly appreciated. The following list is offered as a guide, which can be added to or altered, according to individual ideas and requirements:—

68. *Medicines.*—

Boric powder: Camphorodyne.

Essence of ginger for stomach colic (servants often need it). Tartaric acid and Chlorate of Potash for scorpion stings.

M. and B. 693 tablets for pneumonia and lung troubles.

M. and B. 720 tablets for septic wounds and pneumonia.

M. and B. 125 tablets for septic wounds.

(*a*) Calomel 1-grain tabloids.
Cascara. 2-grain tabloids.
Epsom Salts.
Quinine. 5-grain tabloids.
Mepacrine.
Salicyllate of Soda. 5-grain tabloids (for Rheumatism).
Genaspirin or Aspro.
Tinc. Benzoine. Co.
Hydrogen Peroxide.
Germoline.
Iodex.
Winter Green.
Oriental Balm.
Iodine. Rect.
Essential Oil (for Cholera).

D.D.T.—One of the greatest discoveries of the War and responsible for the saving of thousands of lives from Malaria and discomfort from crawling creatures.

5% solution sprayed in the room or tub or to the walls or sides will kill all insects and small creatures that come in contact with the sprayed surface for 10 days. It may well revolutionise poultry farming and rid the rooms and house of ticks that pester the canine species during the hot weather.

Mepercrine.—Yet another discovery of the War against Malaria, it has no taste or ill effects except perhaps a yellowing of the skin, but for risk of visits to water and jungles that would otherwise be death-traps in north of India.

(*b*) Appliances.
Bandages.
Eye bath. Eye lotion, Sulphate of Zinc, 2 grs. to ounce of distilled water.
Lint.
Cotton wool.
Permanganate of Potash crystals.
Resinol ointment (for burns and wounds).
Surgical knife, scissors, needles, silk in sterilised bottle.
Two thermometers.
Glass syringe in bamboo case.
Z.O. Plaster.
Prontosil (for sceptic wounds).

69. *Wounds.*—Should be washed by some antiseptic, Peroxide or E.C. Carry a curved surgical needle in case stitching should be necessary. Ordinary gut does excellently for this purpose, in the absence of Suture silk.

70. *Foul Hook.*—I have had the misfortune of having a hook cut out of my calf with a blunt penknife, with two massive beings sitting on top of me, so offer a more kindly way as a suggestion. Take a pair of wire cutting pliers, and snip off the hook below the barb, slightly above where it has buried itself, apply a hot fomentation or poultice, and after this has cooled, push the point through the skin forward, DO NOT TRY TO BRING THE BARB BACK THROUGH THE HOLE IT MADE ON ENTERING, or you will suffer agony, and make a nasty mess. Apply iodine, and the wound will heal quickly. If the seat of the wound permits of an incision being made, make a cut along the hook, and it will come away.

71. *Bleeding.*—To check arterial bleeding apply pressure above

the wound, by bandaging or a tourniquet, but if the tourniquet is kept on for more than 20 mins. at a time, without release, there is danger of gangrene. Make sure you have stopped the bleeding, before bandaging the part, or serious loss of blood may result. Tincture of steel applied to the wound, is the best remedy I know. A copy of Moore's Family Medicines for India should be carried in one's kit.

72. *Blisters.*—Never cut or remove the skin, prick on one side and allow the liquid to flow out. Homocea is a good dressing. To ease the feet on long marches on hot days, boric powder dusted into a silk sock will generally prevent blistering of the feet. Zinc ointment plaster (z.o) over a blister or shoe bite on heel or toe, will enable you to walk in comfort, instead of being dead lame; and the part heals under the plaster which does not come off while bathing or washing. This plaster is invaluable for all small cuts and wounds, also excellent as tape for splicing Castle Connel pattern rods.

73. *Boils.*—Boils can be brought to a head with mixture of soap and sugar, and burst by hot poultices.

74. *Stings. Scorpion Stings.*—The best cure for scorpion sting is the immediate application on the seat of the sting, of a pinch of permanganate of potash mixed with a powder of equal parts of Tartaric Acid and pot. Chlorate. Then apply a few drops of water, leave on for as long as the patient can bear it, then apply water freely. This is a drastic treatment, and may leave the seat of the sting sore and blistered, but it will give relief from the hours of pain otherwise suffered. Keep the permanganate and the other powder in separate bottles, and only mix when applying to a sting.

75. *Septic wounds from Tiger and Panther.*—A very serious thing at any time. Epsom's salts freely applied to the wound is effective (in powder form); but best of all, if you can obtain it, is Prontosil. A German preparation, sold in tubes. Hurry off the patient to the nearest hospital, as blood poisoning is almost always the result. M and B. 125 is now the remedy. This is the same as Prontosil not now procurable.

76. *Fever.*—Prevention is better than cure. Whisky and Quinine are good in moderate doses, for one's self, and quinine for the followers. But I find a good day's fishing and Whisky 'dawai' in the evening, with a flitted net to sleep under, is good enough precaution.

77. *Drowning.*—Artificial respiration, if applied correctly, will often bring a patient round, and should be tried out on any case with any visible signs of life.

Professor Schafer's method which is adopted by the Metropolitan Police, and also by the Royal Life Saving Society, is the best. Professor Schafer's method has two very great advantages. First the patient is laid in a prone position, thus obviating the danger of the tongue falling back and blocking up the Pharynx and at the same time helping in the escape of any water remaining in the lungs; and secondly, far less labour is necessary. The whole procedure is exceedingly easy, and there is no risk of any injury to any of the internal organs, and it has this further advantage, that no time need be lost after recovering the patient from the water while removing clothing. But Schafer's method must be applied with some care—rough or hasty usage may result in fracture of the ribs with perhaps fatal results.

The patient should at once be placed face downwards on the ground, with a folded coat or rug if obtainable, under the lower part of the chest, the arms extended in the front, and the face slightly on one side, so as to keep the mouth clear. The operator should place himself on one side of the patient's body in a kneeling position, and facing his head; his hands should be placed flat over the lowest part of the back (on the lowest ribs) one on each side, and the weight of the operator's body should be gradually thrown forward on to the hands, so as to produce firm pressure—which must not be violent—upon the patient's chest. In this way, if there is any water, it is driven out of the patient's lungs.

Immediately afterwards the operator's body is raised slowly, so as to remove the pressure, the hands being kept in the same position. This forward and backward movement (pressure and relaxation of pressure) has to be repeated every four seconds, 15 times a minute, so as to approximate to the natural process of breathing. These movements should be continued, according to Dr. Schafer's instructions, for at least half an hour, or until the natural respirations are resumed.

Shock from lightning, if not serious, should be treated in the same way.

78. *A wife's point of view.*—From THE WOMAN,

'T-t-turn the p-point of the b-boat to the p-p-point of that island!' suddenly stutters my husband. He has just seen a swirl on the water, indicating that a trout is on the move.

Now, what is the perfect wife to do? Around us there are three islands, each of which possesses two points. The boat, not being of the square-sterned variety, has two points. Therefore, I have to choose the correct direction out of twelve possibles—*and in about the fifth of a second.*

Just let me tell you a few of the things expected of me when on the loch with my husband.

I am expected to have a complete and detailed knowledge of the loch, its deep places, its shallow and its skerries. In fact, I must know the bottom of the loch as completely as I know my permanent wave. I am expected to be a first-class oarsman, and must be able instantly to translate a vague wave of the hand into a complicated piece of navigation.

I am expected to fill his pipe exactly to his liking—which is not so easy as it sounds—and I must even light it for him sometimes.

On the few occasions that my husband does hook something, I am apparently expected to fold up the oars and put them out of the way into my handbag.

I am expected to come off the loch feeling bright and cheery after several hours of cold, bleak monotony.

Yes, this fishing is a queer business. At home, my husband is rather faddy about things. The table-cloth must be spotless, the silver must be shining, the glasses must be polished. The tea-table must be 'just it.' Bread must be cut thin and cake thick. Yet, on the loch, he will cheerfully eat sandwiches out of a grubby bag and he will cheerfully drink 'thermos tea.'

At home, an expensive easy chair cannot soothe his limbs. He is restless; he fidgets. First he flings one leg over one arm of the chair; five minutes later he twists around and flings the other leg over the other arm. I often ask him if he would not like to lie on the mat. But, on the loch, he will sit happy for hours on a cold, HARD board. . . .

Why do I do it? Well, m'dear, look at these ducky little fishing hats I wear and, believe me, you can get the most gorgeous sunburn on the loch!

78.—ADDENDUM TO CHAPTER 'SCRAPS FROM MY NOTE BOOK'

For easy reference and convenience, the following blocks, kindly lent by Messrs. Hardy Brothers, Alnswick, England, have been included, with a few details of gut, wire, etc.

GUT SIZES AND DESCRIPTIONS.

Size	*Name of Size*		*Description*
·021 and above		...	Crown
·020	Extra Stout Salmon	...	0/5
·019	Stout Salmon	...	1/5
·018	Fine Stout Salmon	...	2/5
·017	Medium Salmon	...	3/5
·016	Fine Medium Salmon	...	4/5
·015	Fine Salmon	...	5/5
·014	Extra Fine Salmon	...	6/5
·013	Stout Grilse	...	7/5
·012	Grilse	...	8/5
·011	Heavy Lake	...	9/5
·010	Medium Lake	...	0×
·009	Fine Lake	...	1×
·008	Stout Trout	...	2×
·007	Medium Trout	...	3×
·006	Fine Trout	...	4×
·005	...	...	5×

In the specification of all casts listed, the above descriptions are referred to as the thickness of the Casts.

NATURAL GUT IN HANKS OF 50 AND 100 STRANDS.

For those wishing to make up their own traces the following note will help when ordering Gut:—

REFINA.—Fine work.
FINA.—General trout fishing.
REGULAR.—Heavy Trout and course fish.
PADRON. 2nd.—Trout Spinning traces.
PADRON. 1st.—Sea Trout and light grilse.
MARANA. 2nd.—Grilse.
MARANA 1st.—A light Salmon gut.
IMPERIAL.—General Salmon work.
ROYAL.—The heaviest gut.

The best sizes for Mahseer are those listed as 'Fine Stout Salmon' to 'Heavy Lake' sizes 2/5 to 9/5.

WIRE FOR TRACES.

'Punjab' Cable-laid Steel Wire.

Made in 8 sizes as below, in coils of 5 yards only.
Colour Black, plated and oxidized to prevent rust.

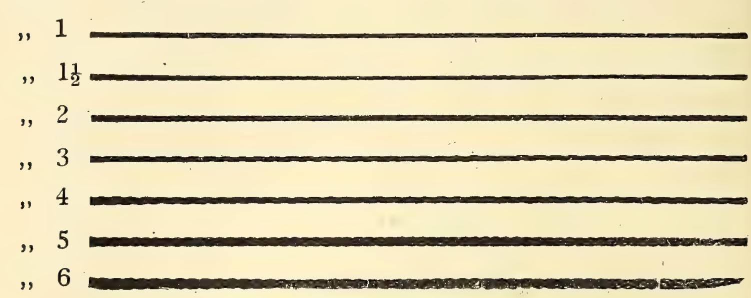

No. 0
,, 1
,, 1½
,, 2
,, 3
,, 4
,, 5
,, 6

Fig. 9.—Breaking Strain.

No. 0	...	19 lbs.	No. 3	...	70 lbs.
,, 1	...	28 lbs.	,, 4	...	85 lbs.
,, 3	...	35 lbs.	,, 5	...	130 lbs.
,, 4	...	50 lbs.	,, 6	...	200 lbs.

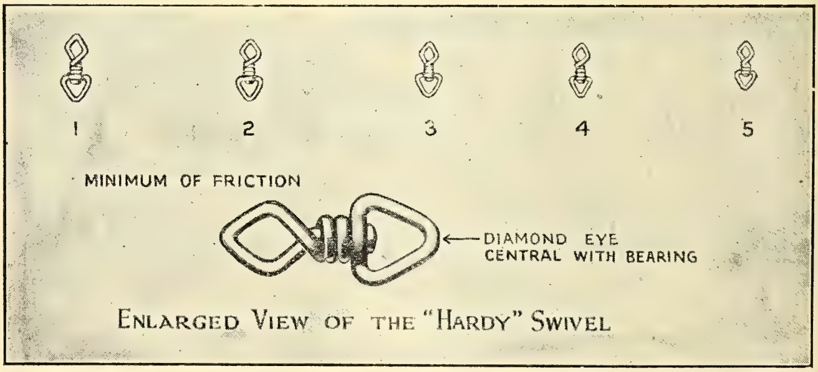

1
2
3
4
5
MINIMUM OF FRICTION
DIAMOND EYE CENTRAL WITH BEARING
ENLARGED VIEW OF THE "HARDY" SWIVEL

Fig. 10 (*a*)—The 'Hardy' Swivel.
(Is ideal for mounting Fly Spoon).

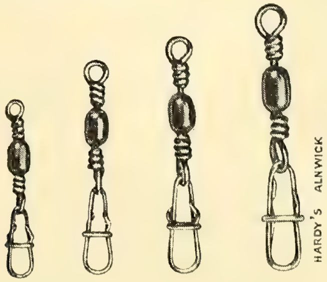
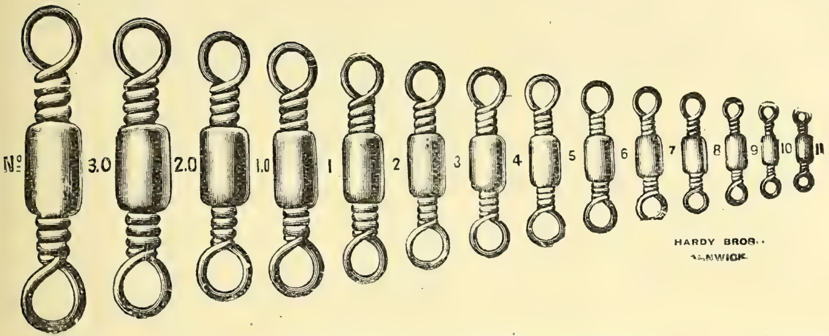

HARDY'S ALNWICK

Fig. 10 (*b*)—The Safety Clip and Close Box Tested Swivel.
(For loading and mounting spoons, such as the Myitkyina Spoon).


No
3.0
2.0
1.0
1
2
3
4
5
6
7
8
9
10
11
HARDY BROS.
ALNWICK

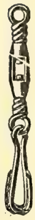


Fig. 11.—Size Scale of Swivels (*Standard*). Link Swivel.

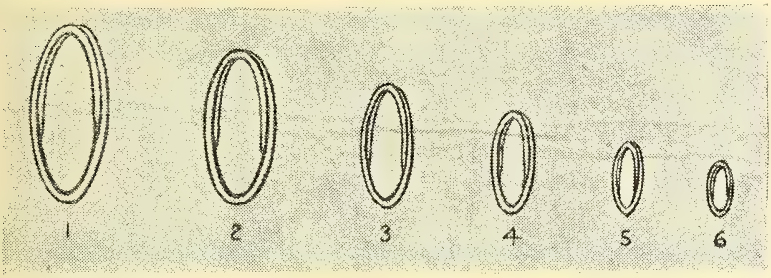


Fig. 12.—Hardy 'Attachment' Links.

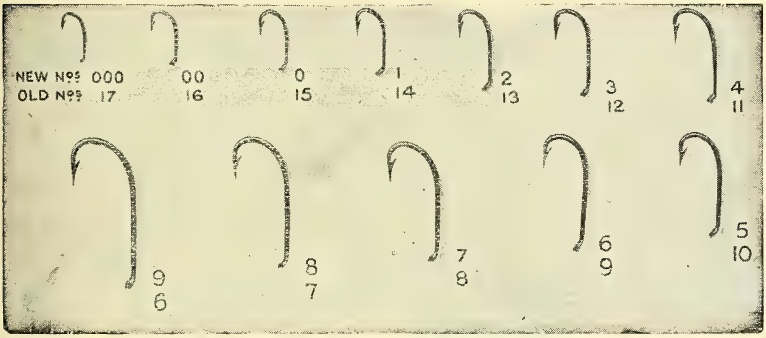

NEW Nos 000
OLD Nos 17
00
16
0
15
1
14
2
13
3
12
4
11
9
6
8
7
7
8
6
9
5
10

Fig. 13.—(*Single Hooks*) Old and New Scale.

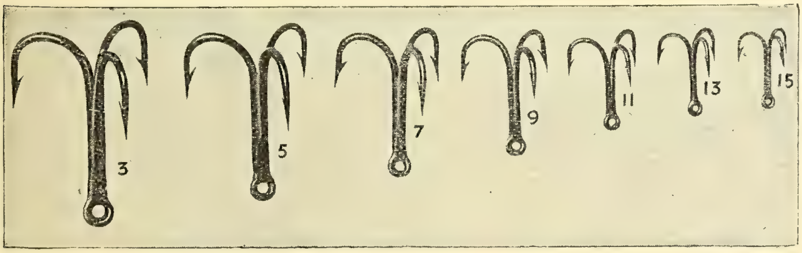

3
5
7
9
11
13
15

Fig. 14.—(*Treble Hooks*) Ordinary Scale.

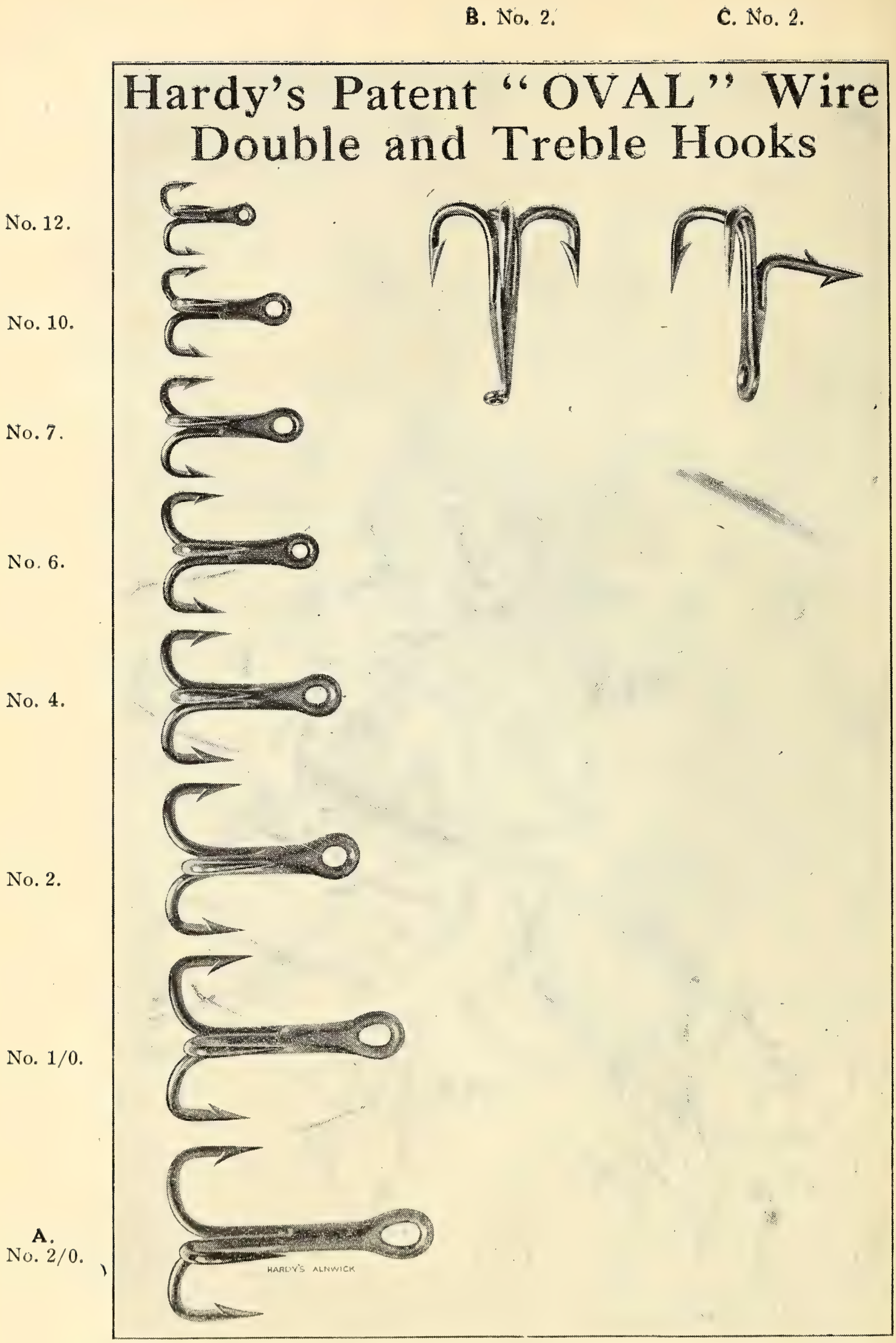

B. No. 2.
C. No. 2.
Hardy's Patent "OVAL" Wire Double and Treble Hooks
No. 12.
No. 10.
No. 7.
No. 6.
No. 4.
No. 2.
No. 1/0.
A. No. 2/0.
HARDY'S ALNWICK

Fig. 15.—Hardy's Patent 'Oval' Wire Treble Hooks.

Extra strong 'Oval' wire. The Best Treble for Mahseer.
A.—Trebles Tapered or eyed.
B.—Double eyed Self-fastening Trebles.
C.—Doubles, spiked, with eyes or tapered.

'T-t-turn the p-point of the b-boat to the p-p-point of that island!' suddenly happy for hours on a cold. HARD board. . . .

THE EARLY STAGES OF INDIAN LEPIDOPTERA:

BY

D. G. SEVASTOPULO, F.R.E.S.

PART XIV.

(*Continued from* p. 198, *Vol.* xlv.)

RHOPALOCERA.

PIERIDAE:

Catopsilia pomona F.

de Nic., *Journ. As. Soc. Beng.*, lxix, 251. 1900.
Bingham, *Fauna Brit. Ind.*, Butterflies, ii, 221. 1907.
Talbot, *Fauna Brit. Ind.*, Butterflies (2nd edit.), i, 495. 1939.

Head green with minute black dots. Body green, the skin very rough and shagreened, the points black. A white spiracular line, above which is a dotted black line and below which is a subspiracular olive green stripe. Venter whitish green. In larvae reared in captivity the black lateral line often develops into a wide black stripe extending to the subdorsal area.

Pupa boat-shaped, the thorax slightly keeled and the head produced to a point. Colour apple green, a yellow line on the thoracic keel and another from the head along the dorsal edge of the wing case and laterally along the abdomen to the cremaster. A dorsal blue line on the abdomen, often very faint. Cephalic point yellow with a black spot at the apex. A faint black line across the eye. Suspended by a girdle and tail pad of white silk.

Food-plant—*Cassia fistula* L. and *C. siamea* L.

Described from a full fed larva found in Calcutta 17-ix-43, pupated 19-ix-43, and a female emerged 24-ix-43.

de Niceville, Bingham and Talbot all quote a description by Bell which gives various points of difference between the pupa of this species and that of *C. crocale* Cr. I have been quite unable to detect the difference in the thoracic angle mentioned, and the black line across the eye is common to both species, not present in *crocale* and wanting in *pomona* as stated. The 'white spiracular band touched with bright yellow on segments 2 to 5' is only found in larvae preparing to pupate, earlier the stripe is white without any yellow.

SATYRIDAE:

Elymnias hypermnestra L., *undularis* Drury.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xl, 397. 1938.

Ovum—Almost spherical, slightly higher than broad. At first creamy white, later yellow. Laid singly on palm fronds, above or below.

1st instar—Head black, terminating above in two short tubercles surmounted by a black spine, two more spines and the vestiges of a third spaced equally, and projecting outwards, between the tubercle and the jaws. When first hatched body pale yellow, after feeding pale green with a darker dorsal line. Under a lens seen to be clothed with sparse colourless hairs, each holding a drop of liquid. Anal processes pale green and terminating in a black bristle.

2nd instar—Similar. The cephalic tubercles larger and branched, the two lateral spines stouter, the vestigial spine obsolete. Body with a yellowish double dorsal line, subdorsal stripe and lateral line. Anal processes blackish.

3rd instar—Similar.

4th (penultimate) instar—Head black with a yellow lateral stripe in continuation of the subdorsal body stripe, and a double pale yellow spot between the cephalic processes. Shape square, the processes larger and spined and a series of small spines along the sides of the face. Body as in previous instar. Anal processes pale orange above and black below, laterally greyish.

Described from larvae bred in Calcutta in October 1943.

NYMPHALIDAE:

Ergolis merione Cr., *tapestrina* Moore.

Sevastopulo, *Journ., Bomb. Nat. Hist. Soc.*, xli, 312. 1939.

Ovum—White. To the naked eye like a speck of mildew, under a lens spherical with a flattened base and covered with fairly long spines, rather like a miniature sea-urchin. Laid singly on the underside of leaves of the food-plant.

1st instar—Head pale brown. Body whitish green with a transverse brown dorsal band on the 3rd, 6th and 10th somites. Head and body with black bristles in place of the branched spines of later instars.

2nd instar—Similar, but with the bristles replaced by short branched spines, all of approximately equal length.

3rd instar onwards similar to adult.

During the first two instars it feeds on the lower surface of the leaf, later on the upper.

Described from larvae bred in Calcutta in August 1943.

LYCAENIDAE:

Chilades laius Cr., *laius*.

Moore, *Cat. Lep. Mus. E. I. Co.*, i, 21, pl. 12, figs. 1, 1a. 1857.
de Nic., *Butt. Ind.*, iii, 89. 1890.
Bingham, *Fauna Brit. Ind.*, Butterflies, ii, 366. 1907.
Sevastopulo, *Journ., Bomb. Nat. Hist. Soc.*, xliv, 417, 1944.

Head small, black, shining and retractile. Colour pale, bright green. A darker green dorsal stripe, narrowing from front to rear, and edged by a paler line. Traces of a double dark subdorsal line. A pale subspiracular line. Ant gland and tubercles not prominent.

Clothed with short, sparse pubescence. The usual Lycaenid woodlouse shape. One larva had the dark markings replaced by deep purple.

When wild, attended by a very vicious, large, red ant, but did not seem to suffer from lack of its attentions in captivity, as all larvae lived through at least one complete instar before pupating.

Like many Lycaenid larvae, it is apt to eat its pupating and moulting companions.

The pupa varies considerably in the amount of black markings, those formed close together or on a dark background are heavily marked and have a certain amount of black suffusion, whilst those formed singly on young leaves are unsuffused and have the markings obsolete or nearly so.

Food-plant—*Citrus* spp.

Described from a full fed larva found in Calcutta 28-viii-43, pupated 31-viii-43 and a male emerged 5-ix-43.

Bingham gives the following description, quoting de Niceville, 'Pale green at all stages, of the shade of the young leaves of the lime and pummeloe bushes on which it feeds. When full grown it is about seven-sixteenths of an inch in length, onisciform as usual; the head black, smooth and shining, with a somewhat dark green dorsal line down the body, the whole surface but very slightly shagreened and covered with extremely fine and short downy hairs. The constrictions between the segments slight. There are traces of two pale subdorsal lines, and there is a pale lateral line below the spiracles. The usual extensile organ on the twelfth segment short. The larva has no distinctive markings by which it can be easily recognised; it is altogether a very plainly coloured and marked insect. I have found it common in Calcutta during the rains, the ant which attends it betraying its presence. The latter has been identified by Dr. A. Forel as *Camponotus rubripes* Drury (*sylvaticus* Fabr.) subspecies *compressus* Fabr. (Now known as *C. compressus* Fabr.)'

HETEROCERA.

ARCTIIDAE:

Nola fuscibasalis Hamps.

Head very pale brownish green. Body pale whitish green with a white dorsal stripe containing a median yellow line. A subdorsal, lateral and sub-lateral series of small tubercles tufted with pale hair, the sub-lateral series largest and with the largest tufts. The colour is an almost exact match of the underside of the leaves of the food-plant and the larva is extremely difficult to see.

Cocoon canoe-shaped, of felted, greyish-brown silk, with a distinct keel, the front truncate and surmounted by two short tufts of silk, sometimes the tufts are longer when there is a second double tuft towards the posterior end. A slit in front through which the imago emerges. Pupa pale olive green, the dorsum tinged with chestnut. Head and anal end obtuse.

Food-plant—*Zizyphus jujuba.*

Described from a full fed larva found in Calcutta 1-xi-43, spun 2-xi-43 and a male emerged 12-xi-43.

LYMANTRIIDAE:

Dasychira pennatula F. (*securis* Hbn.)

Moore, *Lep. Ceyl.*, ii, 95, pl. 115, fig. 1*b*. 1882-83.
Hamps., *Fauna Brit. Ind.*, Moths, i, 454. 1892.
Lefroy, *Indian Insect Life*, 460, pl. 39, fig. 7. 1909.
Gardner, *Indian Forest Records*, vi, 301. 1941.

Ovum—Straw coloured, almost spherical with the top depressed, micropyle an orange speck. Laid in neat batches and covered with a layer of dried froth. Laid 31-viii-43. Hatched 6-ix-43.

1st instar—Head black. Body blackish brown, the thoracic somites somewhat paler, clothed with longish, single, black hairs. 1st somite with subdorsal tubercles. After feeding becomes pale grey with transverse black bands on the abdominal somites. Dorsal glands orange. Prolegs orange.

2nd instar—Very similar, but the ground colour tinged with green and the single black hairs replaced by tufts of greyish.

3rd instar—Similar. Head grey, the clypeus and central part black. The thoracic somites with narrow black transverse bands. All the bands interrupted on the dorsum by a blue-grey spot. Tufts from the subdorsal tubercles on the 1st somite black. Hairs of the lateral tufts plumose.

4th instar—Similar, an intersegmental black transverse dorsal line.

5th instar—Very similar. The ground colour now a definite very pale greenish yellow. 4th somite with a minute rufous dorsal tuft. The grey-blue dorsal markings more extensive. 12th somite with a backward pointing fringe of long black hair.

6th (final) instar—Head grey, clothed with short silky grey hair. Ground colour pale yellow green, with intersegmental black lines and transverse black dorsal bands, 8th somite backwards with a black dorsal stripe. An interrupted blue-grey lateral stripe, immediately below which is a similar silver-grey stripe, the two separated by a black line. Below the silver-grey stripe are two series of black spots. 1st somite with black subdorsal tubercles, tufted with a pencil of long black hair, and a double dorsal wart, the whole with a fringe of forward-pointing grey hair. A subdorsal, lateral and sub-lateral series of greyish warts giving rise to tufts of pale cream hair, the sub-lateral series the densest and containing an admixture of plumose hair. 12th somite with a loose tuft of backward-pointing long black hair. 4th to 7th somites with short dorsal brushes of pale golden hair, each brush rising to a central point. Dorsal glands scarlet. Legs and prolegs orange. Venter blackish speckled with greenish yellow.

Food-plant—Grasses.

Described from larvae bred from ova laid by a Calcutta caught female. All my larvae died soon after entering the final instar, possibly through feeding on too lush grass.

Moore's description is 'Larva black, with a few ochreous hairs along the back and black hairs from the sides, two long tufts of black hairs projected in front of the head and a tuft from anal segment; a short dense dorsal tuft of red hairs on fifth to eighth segments, and a smaller tuft on tenth and eleventh segments; a dorsal and lateral row of green spots, and a similar coloured lower lateral line; head and legs red. Cocoon fusiform, olivaceous green. Pupa olivaceous green, hairy, thorax and wing cases black, abdominal segments with longitudinal black streaks', and this forms the basis of Hampson's description. The dorsal tufts in Moore's figure are dark brown, not red. Lefroy gives an almost unrecognisable figure and no description, but states that it feeds on cereals, grasses, crucifers and other cultivated plants.

SPHINGIDAE:

Acherontia lachesis F.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xliv, 419. 1944.

Brown form—Head pinkish ivory, clypeus outlined in black, a double black line from just outside the clypeus to vertex, and a broad black lateral stripe. Thoracic somites with a broad, olive-brown dorsal stripe, darker at both ends and widening from front to rear and with a whitish median line. An ivory white subdorsal stripe, the lateral area olive brown mottled with darker. Abdominal somites with the dorsal area clay brown, the secondary segmental rings with lines of very minute white-ringed black specks, these specks increasing in size and density on the lateral and ventral areas and also from the 11th somite backwards. A subdorsal blackish spot on the anterior edge of somites 4 to 10. Traces of a blackish spiracular stripe. Spiracles black, very narrowly ringed with yellow. Legs black, speckled with pinkish. Prolegs black. Anal claspers and flap deep olive brown with a pale border. Horn olive brown, the tubercles ivory pink. Thoracic somites with the ridges rather more noticeable than in the green form.

Food-plant—*Duranta ellisii* (Verbenaceae).

Described from a full fed larva found in Calcutta 4-ix-43, buried itself 6-ix-43 and a male emerged 27-ix-43.

Theretra clotho Drury, clotho.

Hamps., *Fauna Brit, Ind.*, Moths, i, 93. 1892.
Hamps., *Ill. Het.*, ix, 57, pl. clxxv, fig. 10. 1893.
Mell, *Biol. u. System. der Sudchin. Sphing.*, 294, pl. xix, figs. 9, 10, pl. xxxi, figs. 8, 9. 1922.
Seitz, *Seitz Indo-Austr. Bombyces*, x, 565. 1929.
Scott, *Journ., Bomb. Nat. Hist. Soc.*, xxxv. pl. iii, fig. 3. 1931.
Bell & Scott. *Faun. Brit. India.*, Moths v. 435, pl. v, figs. 18, 19, 20, pl. xii, fig. 5, pl. xv. fig. 12. 1937.

3rd instar—Head green. Body green, abdominal somites from posterior half of 5th somite backwards minutely speckled with darker. 4th somite with a subdorsal ocellus consisting of a pale blue pupil, palest in the centre, surrounded by a cream ring, wider below than above, and the whole edged by a black line, wide below, very narrow at the sides and above. Traces of a bluish dorsal and a yellowish subdorsal line from the middle of the 5th somite and meeting at the base of the horn. Horn purplish, a black basal spot, the extreme tip whitish, covered with minute hairs, long and straight, and capable of being moved up and down. Spiracles brownish purple. Legs yellowish. Prolegs green. First four somites tapered.

4th instar—Similar, but the ocellus on the 4th somite consisting of a horizontal white linear pupil in a green iris, the whole surrounded by a cream ring and edged with dark blue above and black below. Legs reddish banded with yellow. Horn paler than in previous instar and without the black basal spot.

Final instar—Similar to preceding, except that the horn is of medium length, mauve, minutely tuberculate and slightly downcurved. Dorsal line tinged with mauve. Ocellus surrounded by a dark green line above and deep purple below, the purple diffusing slightly into the cream ring. Subdorsal stripe edged above with dark green.

Brown form—Head brown, the clypeus and a narrow stripe to the vertex paler. Body pinkish brown. A dark dorsal line, almost obsolete on the abdominal somites except on the intersegmental areas. A narrow dark subdorsal stripe from 1st somite to base of horn, edged below with paler. Thoracic somites very slightly speckled with darker dorsally, the abdominal with the speckles arranged in minute checks and with a darker x-shaped dorsal mark on each somite. The ocellus on the 4th somite with the pupil white, the iris olive brown, the surrounding ring cream edged with black, shape as in the green form. Lateral area darker brown on somites 1 to 4, the same colour as the dorsum on the others and with a series of roughly triangular, oblique, dark streaks. Venter dark brown on somites 1 to 4, pale pinkish brown on the others. Legs pinkish. Prolegs dark brown. Spiracles brown. Horn purplish.

When alarmed the head and first two somites are withdrawn into the third, and the ocelli on the 4th somite protrude slightly.

Pupa in a slight cocoon of netted threads spun among dead leaves and litter. Ground colour pinkish bone very heavily suffused and speckled with black except on the dorsum of the first three abdominal somites. A broad blackish green dorsal stripe. Spiracles black. Venter less suffused with black. Proboscis sheath projecting slightly frontally and rather more ventrally. Cremaster black, short and triangular, and ending in two slightly separated points, concave below and with a deep pit running from the base forward into the 13th somite.

Food-plant—*Ampelopsis* sp., *Vitis* sp. Scott adds *Dillenia gyna* Roxb., *D. indica* L., *Hibiscus mutabilis* L., *Fuchsia*, *Amorphophallus*, and Seitz mentions *Cissus*.

Described from a larva found in Calcutta, pupated 27-vii-43 and a female emerged 10-viii-43.

Hampson's description in the *Illustrations* is as follows:—'Pale green, thickly speckled with darker spots and striae on fifth to tenth somites; the fourth somite swollen, bearing a pair of large ocellated spots, green, bordered with yellow above and pink below, and with a central linear white spot; a pale lateral line with dark upper edge from anterior edge of fifth somite to root of horn; stigmata edged with pink; horn purple, stout and curved. Legs pink; claspers green. There is a variety in which the green colour is replaced by brown, with the exception of the ocellated spots, which remain olive green. In some specimens there are traces of irregular diagonal spots between the spiracles. The young larva has a long thin horn, recurved at the tip.', and this, in an abridged form, is repeated in the *Fauna*. Seitz writes 'Larvae green or brown. On the 4th ring a fictitious eye with a horizontal slit pupil, behind this on each ring a blind eye below which there is a dark oblique shadow.' Scott mentions that the blind ocelli may extend from somites 5 to 10, be confined to that on 5 only, or be entirely absent.

LIMACODIDAE:

Thosea cana Wlk.

Moore, *Lep. Ceyl.*, ii, 129, pl. 130, fig. 3*b*. 1882-83.
Hamps., *Fauna Brit. Ind.*, Moths, i, 378. 1892.
Hering, *Seitz Indo-Austr. Bombyces*, x, 713. 1931.

Head green marked with brown above the mouth-parts, retractile. 1st somite green, retractile. Colour pale green with a narrow bluish white dorsal stripe. A subdorsal series of ten shortish green scoli tufted with yellow bristles and a lateral series of ten similar but larger scoli, the first scolus of each series rather shorter than the others. A series of irregular depressed marks edged with yellow between the two series of scoli. A sublateral yellow line. Venter yellowish. Before pupation the colour becomes duller and the dorsum develops a reddish suffusion at each end.

Cocoon of the usual hard Limacodid type, ovoid, of a dark chestnut brown colour. Empty pupa skin brownish yellow.

Food-plant—*Cassia fistula* L.

Described from a full fed larva found in Calcutta 10-viii-43, spun 14-viii-43 and a female emerged 26-ix-43.

All the published descriptions are based on that of Moore:—'Larva onisciform, oblong, convex above, green with a pale yellowish, white dorsal band, a subdorsal row of very short spinous tubercles, and a sub-lateral row of somewhat larger tubercles; spiracles with pale rings. Cocoon oval, purple brown. Feeds on *Cassia auriculata*, etc.'

Thosea tripartita Moore.

Sevastopulo, *Journ., Bomb. Nat. Hist. Soc.*, xlv, 193. 1945.

Head brown, retractile. 1st somite green retractile. Body grass green with a bright blue, narrow, dorsal stripe, edged with darker blue and bordered by a narrow yellow stripe. A paired dorsal series of dull bluish glandular-looking specks, barely visible without a lens. A subdorsal series of ten short, erect, green scoli tufted with greenish bristles, and a sub-lateral series of larger, outward-pointing scoli, the first scolus of each series smaller than the others. A series of irregular sunken marks outlined by a yellow line between the two series of scoli. Ventral surface paler green. When full fed the ground colour becomes bluer and the yellow dorsal stripes fade. Immediately before pupation, the ground colour turns to a golden brown slightly tinged with pink, the dorsal line pinkish.

There is considerable minor variation, one larva had a small white dorsal spot in the middle of the blue stripe on the 4th and 7th somites; another had the dorsal stripe purple with a central white line from 2nd to 4th somites, then blue with a short purple bar surrounding a white spot on the 7th and a purple-ringed white spot on the 10th somite.

Food plant—*Ricinus communis* L. (Castor).

Described from a number of full fed larvae found in Calcutta, one of which spun 31-viii-43 and a female emerged 18-ix-43.

Altha nivea Wlk.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xlii, 288. 1941.

Very young larvae are a translucent greyish-white with a transverse olive brown band anteriorly, centrally and posteriorly, the central band rather broader than the others. Under a lens there is a double dorsal series of six transparent, glassy humps. Later the colour becomes green, but the humps persist until the larva is more than half grown.

When small the larva feeds on the upper surface of the leaf, eating out a narrow, semi-transparent track.

Food-plant—*Ricinus communis* L. (Castor).

Described from larvae found in Calcutta in August 1943.

NOCTUIDAE:

Phlegetonia delatrix Guen.

Moore, *Lep. Ceyl.*, iii, 63, pl. 151, fig. 6*a*. 1884-87.
Hamps., *Fauna Brit. Ind.*, Moths, ii, 391. 1894.
Hamps., *Cat. Lep. Phal.*, xi, 83. 1912.
Gaede, *Seitz Indo-Austr. Noctuidae*, xi, 360. 1937.

Head yellow green, somewhat flattened. Body rather bluer green, the intersegmental folds yellower, a yellow subdorsal line, almost obsolete on the thoracic somites, and a faint yellow spiracular line. A pulsating dark dorsal line. Spiracles yellow. Legs and prolegs very pale green. The younger larvae with the abdominal somites suffused with purplish due to the colour of the food in the intestines. A few short colourless hairs. Shape short and stout, the posterior somites with a somewhat square appearance. Turns purplish just prior to pupation.

Pupa in a slight earth covered cocoon attached to a leaf in captivity, in the wild state probably among litter on the surface of the soil. Dark mahogany, the wing cases, leg and antenna sheathes paler, the intersegmental areas and an indistinct dorsal line darker. Cuticle punctate. The abdomen ending in a blunt cone without any trace of cremaster or bristles.

Described from a full fed larva found in Calcutta 18-vii-43, pupated 21-vii-43 and a male emerged 31-vii-43.

Moore's description is as follows:—'Larva green, paler on the sides; with a slender subdorsal whitish line and a row of small lateral spots. Pupa red, enclosed in a slight cocoon under portions of leaves and excrement', and this appears to be the basis of the other published descriptions.

Achaea melicerte Drury.

Sevastopulo, *Journ.*, *Bomb. Nat. Hist. Soc.*, xli, 319. 1939.

1st instar—Head yellow brown. Body yellow brown, becoming darkish green after feeding. Under a lens with minute black specks giving rise to short colourless hairs. A semi-looper.

2nd instar—Head brown, clypeus filled in with white, and with two white spots on each side of the vertex. Body grey, thickly coated with a white mealy powder. A lateral series of black spots, increasing in size from 3rd to 4th somites and then decreasing again to the 9th, and a dorsal series on the 4th to 7th somites. Traces of a white subdorsal line. 11th somite with a dorsal pair of black tubercles each bearing a black bristle, 12th somite with a similar but smaller pair. Legs black. Prolegs blackish, first pair obsolete, second obsolescent.

3rd instar—Similar to preceding but with much less of the mealy covering. Head with a white lateral blotch.

4th instar—Similar to preceding but without any mealy covering. Ground colour grey minutely speckled with darker. In some specimens the dorsum distinctly blacker than the rest of the body. Lateral black spots ringed with whitish. A transverse black dorsal band on the posterior edge of the 4th somite, with a series of four white spots immediately behind. Head with the ground colour black.

5th (final) instar—There is very considerable variation. In some cases the black dorsal and lateral stripes are wanting, whilst in others the black colouration is increased completely obliterating the usual brown areas, the larva appearing to be black with a whitish subdorsal line, a yellowish supra—and a reddish subspiracular one. In these examples the ground colour of the head is black, the transverse black band on the 4th somite invisible but the spots behind very noticeable. Some of the unicolorous, pale specimens lacked the cream coloured lateral patch on the head.

Food-plant—I have also found this larva on cultivated Roses.

Described from larvae bred in Calcutta in October 1943.

GEOMETRIDAE:

Ptochophyle togata F.

Pupating larva—Head green, bifid. Body green, the abdominal somites with a dorsal stripe composed of small purple blotches.

Pupa formed in the trough of a leaf, the edges pulled together slightly by a few strands of white silk, attached by the cremaster and a girdle to a slight carpet of white silk. Colour frosted green, the head and prothorax truncate and olive brown in colour. Cremaster purple brown. The end of the abdomen just anterior to the cremaster is angled so that the pupa stands at an angle of about 45° from the vertical.

Described from a pupating larva found in Calcutta 28-viii-43. Pupated 28-viii-43 and a female emerged 1-ix-43.

PYRALIDAE:

Zinckenia perspectalis Hbn.

Head brownish black, very shiny. 1st somite with a shiny, brownish black dorsal plate, divided in the middle by a white stripe. Body green, paler below the spiracles. A pulsating dark dorsal line, a pale spiracular line. A few single colourless hairs. Legs and prolegs almost colourless. Turns red before pupation.

Pupa in a silk-lined cell formed by biting through a leaf of the food-plant almost to the centre vein and joining the two flaps thus formed together. Pale chestnut brown, not very slender, the leg and proboscis sheathes not extending beyond the wing cases. Male pupa with a small projection behind the eye, containing the tooth on the antenna.

Food-plant—Garden Balsam. The larva spins the leaves at the tip of a shoot together and lives and feeds within.

Described from a full fed larva found in Calcutta 26-viii-43, pupated 29-viii-43 and a male emerged 5-ix-43.

Phryganodes analis Snell.

Head very pale ivory white, the mandibles blackish and with a fine blackish line above the antennae. Body with the thoracic somites very pale buff, the abdominal bluish white, the colour due mainly to the contents of the intestines. A pulsating dark dorsal line. Legs old ivory. Prolegs bluish white. Spiracles white. Somites rather deeply divided, thoracic somites somewhat flattened. A few, fairly long colourless hairs. Turns pink before pupation.

Pupa in a folded leaf lined with white silk. Reddish brown, slender. The cremaster fairly long and fixed in the silk lining of the leaf.

Food-plant—*Cassia fistula* L., spinning two leaves together and living and feeding between.

Described from a full fed larva found in Calcutta 28-vii-43, pupated 31-vii-43 and a male emerged 8-viii-43.

Lepyrodes neptis Cr.

Head yellow green with a blackish lateral line. Body jade green, rather more opaque than most Pyralid larvae, with a darker dorsal stripe. 1st somite with a very minute black subdorsal dot, 2nd somite with a slightly larger dot. A few short colourless hairs. Lives in silk-lined, spun-together leaf.

Pupa in a spun-together leaf. Emerald green with a darker dorsal abdominal line. Very long and slender, the head produced to a snout, the body widest just before the middle of the thorax and then tapering towards the cremaster. Legs and antenna cases very long and extending almost to the end of the abdomen. Cremaster a black triangular point armed with short hooked spines.

Food-plant—Jasmine.

Described from a full fed larva found in Calcutta 3-x-43, pupated 5-x-43 and a male emerged 10-x-43.

Leucinodes orbonalis Guen.

Cotes *Indian Museum Notes*, iii, 100.
Lefroy, *Indian Insect Life*, 518. 1909.

Head chestnut brown. 1st somite with a brown dorsal plate. Body pinkish brown with a darker dorsal line. Anal plate blackish brown. 2nd and 3rd somites with a transverse series of six olive green warts bearing colourless bristles. Abdominal somites with a subdorsal, suora- and sub-spiracular series of similar, but smaller, warts, all of which are only visible under a lens. Venter and prolegs very pale pinkish brown. Legs blackish. Spiracles blackish. Turns pink before pupation.

Pupa in a flat cocoon of pinkish, parchment-like silk spun between leaves, in nature probably among dead leaves on the ground. Stoutish, the dorsum of the abdominal somites deep pink, the venter pale yellow, thorax and wing cases brownish yellow. Leg and proboscis sheathes extending slightly beyond the edge of the wing cases. Cremaster short, spade-shaped and fringed with very fine hooked spines.

Food-plant—Various species of Solanaceae, feeding in the fruits.

Described from a full fed larva found in Calcutta 15-x-43, spun 17-x-43 and a female emerged 23-x-43.

Lefroy describes the larva as being pink, smooth and almost hairless, boring in the fruit of wild and cultivated Brinjal.

Pyrausta incoloralis Guen.

Head yellowish green, bearing a few colourless bristles. Body rather bluer green, chiefly due to the contents of the intestines. A white spiracular line. 2nd somite with a minute black subdorsal speck. A few colourless hairs. Legs and prolegs pale glassy green. The larva lives under a web spun on the underside of a leaf of the food-plant and is extremely difficult to detect as the colour of the silk is an exact match of the silver-grey colour of the leaf.

Pupa in a cocoon of fairly dense white silk spun in a turned over leaf. Very pale green, the abdominal somites tinged with whitish. A very fine transverse brown line dorsally on the posterior edge of the 1st, 2nd and 3rd abdominal somites. Leg and proboscis sheathes slightly longer than the wing cases. Cuticle of abdomen very minutely punctate.

Food-plant—*Calotropis procera* Br.

Described from a full fed larva found in Calcutta 12-xi-43, pupated 16-xi-43 and a female emerged 24-xi-43.

(*To be continued.*)

SOME OBSERVATIONS ON SOUTH INDIAN COMMELINAS; TWO NEW SPECIES OF COMMELINA FROM SOUTH INDIA.*

BY

EDWARD BARNES

(*With two plates*)

It is well-known that in the genus *Commelina* the spathe usually contains two cymes, that the flowers of each cyme open one at a time and remain open only for a few hours, and that the flowers of the inner cyme are often infertile. Very little further information about the flowering of these plants appears to be available. The writer has made observations on the sequence of flowering in a number of South Indian species, the details of which are recorded below under each species. It is found that each species has a more or less characteristic behaviour, the average interval between the opening of successive flowers, and the variation of this interval, differing in different species. This behaviour is no doubt affected by temperature, humidity, fertility of soil and other external factors, but it appears to be largely characteristic of the species, as most species will grow and flower only between certain limits of warmth and moisture.

An interesting fact noticed during these observations is that the development of the pistil in a flower of the outer cyme depends on whether or not the previous flowers of that cyme have been fertilised and are forming capsules. Usually the first few flowers on the outer cyme have completely developed and fertile pistils. After one or more capsules have been set, subsequent flowers have pistils aborted to various degrees. The stages of abortion are usually—shortened style, further shortened style which remains coiled, small ovary and almost no style, vestigial ovary. In all flowers the stamens are fully developed and fertile. If, however, each flower is removed after opening, or even if the partially

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*Except for a few very minor details, the MS. of this article was complete at the time of my husband's death. Owing to the difficulty of correspondence with Britain during the War, he was unable to send specimens of the two new species to Kew Herbarium for examination and report, and he planned to consult specialists in India before publishing the descriptions. This he was prevented from doing by illness and death. He had, however, named both species, and written the Latin diagnosis for *C. indehiscens*. Thanks are due to Mr K. Cherian Jacob of the Government Agricultural College, Coimbatore, and Dr S. K. Mukerjee, Curator of the Herbarium of the Royal Botanic Garden, Calcutta, for their kindness in scrutinising specimens and studying the written descriptions. They have confirmed my husband's opinion that both *Commelina indehiscens* and *Commelina tricolor* are new and distinct species. Dr Mukerjee kindly supplied the Latin diagnosis for *C. tricolor*.

ALICE M. BARNES.

developed capsule or capsules are removed from the cyme, the subsequently opening flowers develop fertile pistils. On the other hand, the removal of the whole outer cyme from a spathe while in bud does not appear to induce the infertile flowers of the inner cyme of that spathe to develop pistils, although vestigial pistils may be present, and although perfect flowers producing capsules may very occasionally occur on the inner cyme in that species.

In identifying the plants used, it was found that both the published descriptions and the reference herbarium material are often incomplete. This is especially the case as regards the flower. The petals are very delicate, soon shrivel and stick to the pressing paper; the filaments and style although slender are succulent, and they coil together and lose most of their characteristics on drying. Consequently very few herbarium specimens have flowers of which the details can be made out. As the original descriptions of a number of species were made from herbarium material, the details of the flowers appear never to have been recorded in these cases. It therefore appeared to be desirable to give a description of the living flower, especially as the flower does not appear to vary much in the different forms of the same species, and as there are sometimes characteristic features or combinations of features useful in identification.

In this genus identification is frequently difficult. Not only are the flowers often undescribed or inadequately described, but the leaf and stem are often very variable, and in most species there are a number of forms or varieties differing in habit, hairiness and other characters. Classification is based largely on the characters of the spathe, capsule and seed. But unfortunately, in spite of free flowering, it is often remarkably difficult to find ripe capsules and seeds of the plants in the wild state. Probably birds or field mice search systematically for the maturing capsules. This may account for the fact that many herbarium specimens are without mature capsules and seeds, and it is not surprising that much confusion exists as to their identity. In order to establish the identity of the plants referred to, and because the details, if recorded, are not easily available, descriptions of the spathe, capsule and seed have also been given in this article for each species.

Method of Observation:

The method of observing the sequence of flowering was very simple. A small numbered ticket was attached to each spathe when it first flowered, and each morning it was recorded which marked spathes had flowers; the state of development of the pistil in each flower was also noted. As far as possible observations were made on plants growing in their native habitat. It was found, however, that such plants suffer many casualties. The flowers and spathes are attacked by many insects, and the plants being succulent are sought for by browsing animals. Consequently with unprotected plants only a small proportion of marked spathes usually survives for complete observation. Where observation could not be made in the field, the plants were planted in pots and kept in the writer's garden, but observation was not begun for some weeks or months so that the plants should have become acclimatised to their new situation.

A Method of Preserving the Flowers:

As it is very desirable that herbarium material should include well-preserved flowers, the following simple method of collection and treatment is given. The flowers are usually open only in the morning and shrivel soon after collection. They should therefore be pressed on the field. A small easily portable press about 10 x 6 ins. made of 3-ply wood and with three butterfly screws, and containing sufficient absorbent paper, is convenient. An envelope containing pieces of good quality white tissue paper about 2 ins. square and folded double should be kept in the press. In addition to complete specimens of the plant, several flowering spathes should be gathered. The spathe should be opened out and any mucilage absorbed and then the flower and open spathe should be carefully pressed between a folded tissue paper. The pressing paper should be changed without opening the tissue papers till the flowers and spathes are quite dry. Then a quantity of Canada balsam diluted with toluene or xylene is applied to both sides of each folded tissue paper which is then pressed between two microscope slides so as to expel air bubbles and excess of balsam. The slides are then dried in a warm place. If the tissue paper is of good quality, it becomes almost completely transparent in Canada balsam, and the details of the flower can be clearly seen even with a lens. The colour of the petals is not affected by long exposure to light if preserved in this way. Instead of using glass slides, a patch of Canada balsam may be applied to each side of the folded tissue paper over the flower. After drying for some days, these papers may be mounted on the sheets with the rest of the plant. The result without glass is not however very permanent as after some months or years the Canada balsam turns brown and the colour of the petals fades.

Some observations have also been made on self-fertilisation by the coiling together of the stamens and style. In some species this coiling is highly developed and is very successful in ensuring fertilisation, while in others it is quite ineffectual. The style and the anthers of the lateral stamens are coiled in the bud, and the coiling in the latter stages of flowering is apparently a reversal of the process of expansion. Only in some species has this movement been elaborated and adapted to self-fertilisation. The fact that coiling of the anthers occurs in male flowers as well as in perfect ones suggests that the action is purely mechanical.

In some species the spathe contains mucilage in which the flower buds remain immersed. The purpose of this mucilage appears to be to prevent the buds from being attacked by aphides and other small insects. The buds of species that do not produce mucilage, such as *C. clavata* and *C. indehiscens*, are often much attacked by aphides which are placed in the spathes by small ants.

Some brief notes about distribution, forms and habits are given. It is remarkable that even the colour of some common species does not appear to have been correctly recorded. Some species have several different forms differing in leaf, size and shape and in habit. Some of these forms appear to be sufficiently distinct to be given the status of varieties, but much more complete collections and many more field observations appear to be necessary before this can be usefully undertaken.

Commelina nudiflora Linn.

Flower and Spathe.

Spathe rather variable in shape, ovate-cordate, tapering to an acute or acuminate tip, the two halves folded together, or oblong-lanceolate, the two halves folded together at the base but the upper portion flat and ligulate with a more or less rounded tip, up to 3.5 cms. long and 1.5 cms. broad (opened out), glabrous, without mucilage; peduncle slender, from about half as long as the spathe to much longer, sometimes slightly hairy at the upper end, solitary, leaf-opposed. Inner cyme branch nearly twice as long as the outer.

Two anterior sepals broadly ovate, concave, joined together at the base for about 1/3 their length, white or tinged blue, with 2 or 3 obscure greenish nerves, tips rounded; posterior sepal broadly boat-shaped, with 3 or more prominent green nerves, tip incurved. Two posterior petals cordate-reniform, unequal-sided, .6-.7 cm. dia. claws narrow, at about right angles; anterior petal a little smaller, cordate, concave, margin irregular, tip rounded or bluntly triangular, claw very short; all usually deep blue, sometimes paler. Two lateral stamens with long blue filaments and small anthers with blackish margins; median stamen with shorter filament, another larger, deep yellow, the cells curved and diverging at the base, connective between the cells white or blackish. Pollen grains yellow, narrowly ovoid, with a longitudinal groove, surface smooth, minutely pitted, rather variable in size, .04-.05 x .02-.03 mm. Staminodes more often 2 than 3, filaments slender, blue, about half as long as those of the lateral stamens heads yellow with two long large lobes and usually several small round ones; third staminode when present often without a head. Ovary ovoid narrowed to the style, papilose, pale green: style about as long as the longer stamens blue curved forward.

Sequence of Flowering.

There are normally two cyme branches in the spathe. The inner bears usually one but sometimes up to 3 flower buds. With very few exceptions the first two of these on opening are found to be male; the third does not mature. Of the 3 or 4 flower buds on the outer cyme branch the flower developing from the first is almost always perfect, but only a small percentage of second and third flowers have fully developed pistils, and the fourth rarely opens. Plants from Chembarambakkam and from the Unamalai Hills, both in the Chingleput District, were grown at Tambaram and 123 spathes were marked between December and April. Of these on first flowering, 99 had a perfect flower on the outer branch only; in 15 there were both a male on the inner and a perfect flower on the outer branch; 6 had a male on the inner branch only; 2 had perfect flowers on both cymes, and one had an imperfect flower on the outer cyme branch. Of those that first produced a perfect flower on the outer branch, 37 next had a male flower on the inner branch (25 next day, 7 after an interval of 1 day, 5 after 2 days, 3 after 3 days, 1 after 5 days). Of the 15 that first opened flowers on both branches, 3 next opened a second male on the inner branch (after 2 days), and 2 produced an imperfect flower on the outer branch (after 1 and 2 days). Two of the spathes that first had a male on the inner branch next opened a perfect flower on the outer branch (after 1 and 2 days), and one had an imperfect flower on the outer branch (after 1 day). The 2 spathes that had a perfect flower on each cyme produced an imperfect flower on the outer cyme after one day, and one of these opened a second perfect flower on the inner branch on the following day. Of the other spathes that were in flower on a third occasion, 14 had perfect and 17 had incomplete flowers on the outer branch; 2 had second male flowers on the inner branch, and one had a male on the inner and a perfect flower on the outer. Very few spathes produced a further flower, and these were mostly incomplete ones on the outer branch.

Plants from Palmaner (Chittoor District) grown at Tambaram behaved similarly. Of 10 spathes, 7 produced first a perfect flower on the outer branch, followed in 3 cases by a male on the inner next day or after an interval of one day; 3 had a male on the inner and a perfect flower on the outer branch on first flowering, followed after an interval of a day by a second perfect or imperfect flower on the outer branch.

Plants from Trivandrum also behaved in a similar manner except that more frequently two flowers opened on the inner cyme branch with intervals of 1 to 3 days.

As in the case of *C. kurzii*, the removal of a perfect flower has the effect of causing the next flower to become perfect. The perfect flowers on the outer branches of 7 spathes were cut off. In each case the second flower was perfect. These were removed and the third flower was also perfect. From 6 spathes the capsule which had developed on the outer branch of the cyme was removed. In five cases the next flower on this branch was perfect, and in the other the flower had an imperfect pistil. Occasionally a flower on the inner cyme branch is perfect and a capsule may be formed. It was thought that by completely removing the outer cyme branch some days before a flower opened, the flower or flowers of the inner cyme might become perfect. However, after removing the outer branch of the cyme while in bud from 6 spathes, it was found in each case that the flower that later opened on the inner cyme branch was male.

Self-fertilisation.

The filaments of the lateral stamens coil strongly and the filament of the median stamen also coils at its upper end. The style bends so that the stigma usually comes in contact with the anthers. The staminodes do not usually coil. An examination of numerous spathes with capsules showed that in most cases a capsule was formed from the first flower of the outer branch. This suggests that self-fertilisation is usually effective.

Capsule and Seed.

Capsule ovoid-oblong, slightly constricted at the middle, buff-coloured, surface smooth or very finely furrowed, tip shortly cuspidate, 3-celled, 2-valved, 2-cells, 2-seeded, posticous cell 1-seeded and indehiscent. After dehiscence both valves remain attached to the pedicel. The peduncle becomes more or less deflexed before the capsules dehisce, and so the seeds of the two anticous cells usually fall out. Some time after dehiscence the peduncle becomes detached from the plant, and the brown and shrivelled spathe containing the 1-seeded indehiscent cell of the capsule falls to the ground and is likely to be blown to some distance by the wind. Not infrequently two capsules mature on the outer cyme branch. Very rarely there may be a capsule on the inner branch.

Seeds ovoid, truncate at one end, 2.5-3 mm. long, greyish-black, cindery, surface coarsely reticulate and with finer reticulations in the pits, one face flattened and with a longitudinal ridge (hilum), one edge with an obscure round pit with a blunt process at the centre (micropyle).

From flowering to dehiscence of capsule averages about 18 days, variation 16 to 21 days.

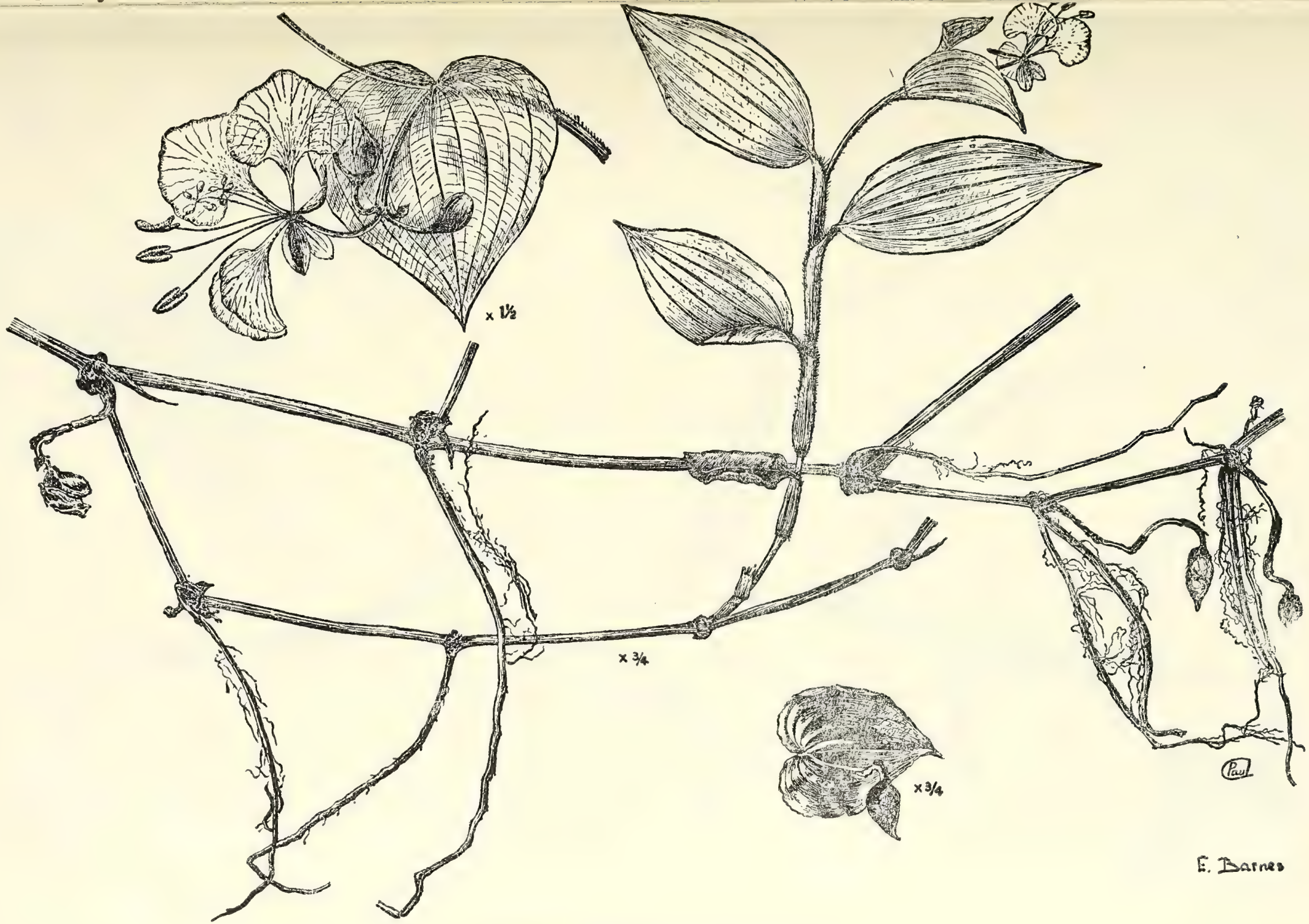
Distribution.

This plant is common on the margins of ponds and in other wet places on the plains and up to the Mysore Plateau (Chingleput, Nellore, Chittoor, Trivandrum). It roots very freely at the nodes, the roots often being 6 inches long or more before reaching the ground. The roots are fibrous. The plant is an annual but is able to persist if conditions remain moist.

Commelina indehiscens E. Barnes sp. nov.

C. nudiflorae Linn. affinis, sed major, capsula 1-sperma indehiscente, floribus cleistogamis, capsulis subterraneis differt.

A much branched extensively-running prostrate, probably perennial herb. Roots long and fibrous. Stems round, up to about .6 cm. in diameter, glabrous, green, often with red longitudinal striations. Leaves ovate to broadly lanceolate, slightly unequal-sided, up to 13 cms. long and 3.5 cms. broad, usually smaller, apex acute or acuminate, base rounded and then narrowed to a petiole up to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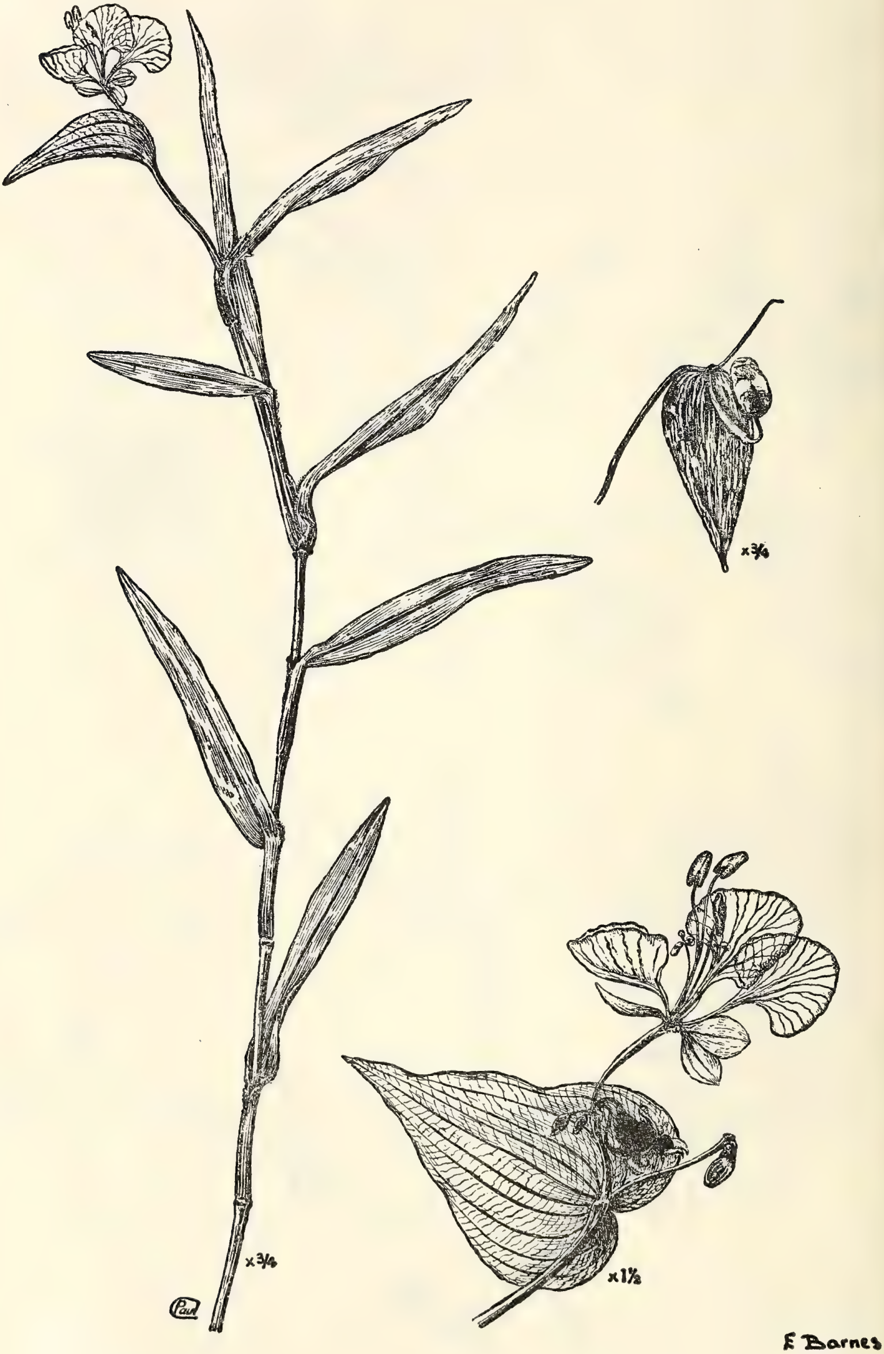
x ¾
x 3/4
Paul
E. Barnes

Commelina indehiscens Barnes *Sp. Nov.*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x3/4
x1½
Paul
E Barnes

Commelina tricolor Barnes *Sp. Nov.*

about 1 cm. long, with short stiff somewhat bulbous-based hairs on both surfaces, sometimes almost glabrous, margin minutely serrate; sheaths up to 2.5 cms. long, strigose, mouth ciliate, often lax and striated and mottled with red. Spathes broadly cordate, apex acute, the two halves folded together, usually about 2 cms. long and broad (opened out), sometimes larger, outer surface somewhat strigose; peduncles up to 3 cms. long, strigose, leaf-opposed. Posterior sepal boat-shaped, apex narrowed and concave; anterior sepals ovate-orbicular, concave, fused together for about 1/3 of their length, colourless and transparent. Posterior petals with broadly reniform or deltoid lobes, up to about .9 cm. diameter, claws slender, at about right angles to one another; anterior petal a little smaller, sometimes with a blunt triangular apex, claw short; all bright blue. Staminodes 3 or 2; filaments slender, about as long as the median stamen; heads yellow, with 2 larger and 2 smaller lobes on narrow stipes, often wanting in the posterior staminode. Lateral stamens with long, slender more or less straight filaments; anthers small, yellow margined with bluish-grey, cleft at the base; median stamen with shorter filament and larger anther the cells of which diverge at the base. Pollen grains ovoid-oblong, slightly curved, .07-09 x .04 mm., surface finely and densely spinulose. Ovary slightly papillose tapering to the style, 2 cells 2-ovuled, 1 cell 1-ovuled; style a little longer than the stamens, curved forward. Capsule indehiscent, 3-celled, 2 anticous cells linear, empty, posticous cell gibbous, keeled, 1-seeded, apex acuminate, sometimes curved, surface light brown, finely wrinkled. Seed (after removing the adhering cell-wall) ovoid, .5 cm. long, black, surface reticulately pitted, the ridges forming the reticulations brown, irregular and with short lateral branches, a round pit with a central point on one side (micropyle).

Sequence of Flowering.

Plants from the Billigirirangan Hills were grown at Tambaram and 28 spathes were marked (Feb. and March). Their flowering was found to be much more irregular than any other species examined. Six of these spathes had a small leaf in place of the inner cyme, and 13 others had no inner cyme, or it did not mature any flowers. The remaining 9 spathes had together 18 flowers on the inner cyme; 13 of these were male or had an incompletely developed pistil, and 5 were perfect, three being on the same cyme. On the outer cyme branch, 7 spathes first produced one or more perfect flowers to be followed by flowers with pistils aborted to various degrees. Successive flowers followed on the next day in 7 cases, after an interval of 1 day in 11 cases, and after an interval of 2 days in 5 cases. As judged by other species, this may be regarded as the probable normal behaviour. Seven other spathes, however, behaved in the opposite manner, producing first one or more male or imperfect flowers and then producing perfect flowers. Three spathes produced only imperfect flowers on the outer cyme. Nine others produced only perfect flowers on the outer branch, several having as many as 7 opening on successive days, or after an interval of 1 day. No capsule was formed in these nine spathes, as self-fertilisation does not occur in this species.

Self-fertilisation.

The lateral stamens coil only after the petals have begun to wilt. The staminodes do not coil and the median stamen does not appear to coil although it becomes curved inwards as a result of the shrivelling of the petals. The style does not coil but remains erect when the flower has completely shrivelled. Self-fertilisation therefore does not usually occur. The small percentage of capsules set by perfect flowers when the plants are grown where they are not visited by the insects of their native habitat, confirms this (see above). The same plants when pollen was transferred by a brush, produced capsules readily.

Underground Capsules.

On examining the root system it was found that at a number of nodes, in addition to several roots, slender underground stems bearing capsules have their origin. These underground stems are white, having usually 4-6 nodes, each with a scarious ovate acute leaf about .5 cm. long or less. A small root usually emerges from the node just above the capsule. The capsules are similar to the normal capsules but are stouter and with less acute tips; they also contain a single seed in the posticous cell. The seed is .6 cm. long with the surface very obscurely reticulate. These capsules originate from underground cleistogamous flowers.

No underground cleistogamous flowers were found, but several flowers intermediate between normal and cleistogamous ones were seen. These are formed when the node bearing a slender lateral branch that would normally produce a cleistogamous flower is not in contact with the ground owing to a rock or other obstacle, and so the lateral branch is not able to penetrate the soil. Such branchlets are strongly geotropic and run vertically from the node towards the ground. They bear at their ends a very small green spathe containing one or two reduced cymes. Each of the spathes seen had a flower on the outer branch. These flowers had 3 blue petals more or less equal in size but much smaller than in normal flowers. They had well developed pistils but with short styles; and three staminodes. One had all three stamens fertile; in one the lateral stamens only had a little pollen; and the other had all three anthers infertile. The flowers were facing the ground and one was face downwards on the ground.

Occurrence.

This plant occurs in swamps and on the margins of streams in wet evergreen forest on the Billigirirangan Hills, Mysore, at about 4,000 ft.—Minchiguli Valley, and near Bedaguli. It flowers in June when the underground capsules are also present. Plants seen in September had neither flower nor underground capsules. It was also found to be common in the Ouchterlony Valley, Western Nilgiris, along streams at about 3,000 ft., and in the Nilgiri Wynaad about a mile west of Nadgani, flowering and with underground capsules in August. It was also found at Palaar, Travancore High Range, Fl. May Nos. 1527, 1776, 2135-7, 2163-5, 2296.

The spathe, after a capsule has formed and the flowering is over, becomes deflexed so that the open edge rests on the ground.

A stem that was measured was 7.35 metres long and was still growing. It had rooted at most nodes and at 24 of these nodes there were semi-erect leafy branches up to 25 cms. long. The same plant had a number of other main stems several metres long, running in other directions. About half the flowers seen had only 2 staminodes.

This plant is probably common in evergreen forest at 3-4,000 ft. It superficially resembles *C. clavata* (Clarke), and has probably often been mistaken for it. The indehiscent capsule is a unique character, and the combination—complicate, not funnel-shaped, spathe and cleistogamous flowers—distinguishes this plant from other South Indian species.

Commelina hirsuta Clarke.

Spathe and Flower.

Spathe solitary, leaf-opposed, lanceolate or ovate-lanceolate, 1.8 to 4.0 cms. long, 1.0 to 1.5 cms. broad (opened out), the two halves folded together, base rounded or somewhat cordate, apex acuminate, margin dark red, with stiff white slightly bulbous-based hairs along the basal half or throughout, outer surface sub-glossy, with very short hairs, mucilage absent or scanty. Peduncles slender, up to 7·5 cms. long, hirsute, often reddish. Inner cyme branch usually barren and only a few mm. long, hairy, tip pointed, rarely bearing a single flower with an undeveloped pistil; outer cyme branch 3-to 5-flowered, broad, channelled on the inner side, hairy, often with a very narrow collar-like bract below the pedicels; pedicels hairy. Posterior sepal broadly boat-shaped, with 3 broad green veins, margin colourless; anterior sepals obovate-oblong, fused together near the base, concave, colourless with 1 or 2 diffuse veins. Posterior petals orbicular unequal-sided at the base, up to 1.3 cms. dia., margin irregularly crenate sometimes shallowly toothed, claws rather short; anterior petal a little smaller, cordate, apex bluntly triangular, claw short; all petals deep turquoise blue. Two lateral stamens with rather thick, nearly straight, blue filaments and large yellow anthers, the cells separated at the base; median stamen similar but filament about 2/3 as long and anther cells diverging below. Three staminodes with slender filaments 1/3 to ½ as long as those of the lateral stamens, heads small and variable in shape, usually with an irregularly roundish on pear-shaped lobe or two-lobed, white, blue or purple. Ovary tomentose; style about as long as the lateral stamen, more or less straight and erect; tip turned back, blue.

The small staminodes with irregular heads, and the dark turquoise blue petals are characteristic.

Sequence of Flowering.

There is a longer interval between the opening of successive flowers of the same spathe in this species than in any other studied. For 37 cases of plants growing on the Nilgiris at 6,500 ft. and flowering in June to August the avearge interval was 5.2 days. The periods were:—3 cases 3 days, 7-4 days, 11-5 days, 13-6 days 3-7 days. The first flower on the outer branch is perfect and subsequent flowers are perfect till a capsule is formed, after which some flowers have an undeveloped pistil with short white coiled style, but most are perfect. The last one or two buds on the cyme do not usually develop.

Self-fertilisation.

Only the filaments of the lateral stamens coil and these complete only about one coil. Neither the style, the staminodes nor the median stamen coil before the petals shrivel. As the style is erect and its tip turned away from the stamens the motion of the anthers of the lateral stamens on coiling does not bring them near the stigma, and so self-fertilisation is not brought about by these movements. The petals on shrivelling close over the stamens and style, and it is possible that occasionally the stigma may thus be bent down to the coiled stamens. On wet days the shrivelling of the petals may not occur till nightfall. Observatoin shows that only a very small percentage of flowers form a capsule, more than one capsule being found in a spathe only verry rarely, and often there is none.

Capsule and Seed.

Capsule 4.5 mm. long; anticous half ovoid-oblong, flat, green, hairy, with a slightly narrowed tip; posticous half broadly semi-ovoid, glabrous, yellowish, slightly keeled and wrinkled; 2-valved, 3-celled, posticous cell one-seeded, the other two cells empty or with an undeveloped seed. Seed ovoid flattened on one side about 4 mm. long and covered by the firmly adhering cell wall.

Occurrence and Habit.

This is a characteristic plant of the high grasslands (6,500 ft. and above); in wet regions, as on Gudalurmalai, Nilgiris, it occurs down to 6,000 feet or a little lower. F.M.P. gives 'Flowers yellow drying deep blue,' which is apparently taken from F.B.I. Fyson gives 'Flowers blue, yellow on the plains'. All flowers seen by the writer were intensely blue. When growing among short grass it becomes tufted, probably owing to grazing; in thickets and tall grass its stems are long and straggling. Occasionally glabrous plants are found. At lower nodes there is a cataphyll between the peduncle and the stem and clasping the stem.

Commelina clavata Clarke.

Spathe and Flower.

Spathes ovate-cordate, acuminate, the two halves folded together but usually somewhat apart towards the tip, without mucilage, usually about 3 cms. long and 2 cms. broad (opened out), margin ciliate near the base, inner surface glossy, outer with scattered short stiff hairs; peduncle solitary, leaf-opposed, usually as long as or longer than the spathe, with stiff downward-pointing hairs denser near upper end. Cyme branches 2; inner about twice as long as outer, usually 1- or 2-flowered, sometimes 3-flowered; outer usually 4-flowered occasionally with 5 or 6. Two anterior sepals broadly ovate, concave whitish or flushed blue, joined only near the base; posterior sepal broadly boat-shaped, white, with 3 green nerves. Two posterior petals orbicular-reniform, about 1 cm. dia., with narrow straight claws standing at about 60° to each other; anterior reniform, a little smaller, with a short broad claw, sometimes with a blunt triangular apex obscurely toothed margin; all bright blue. Three posterior stamens modified to staminodes; filaments slender, about 2/3 as long as those of longer stamens, blue; heads with 4 rounded yellow lobes with thick dark brownish-red attachments, sometimes 2 smaller lobes also present. Two lateral stamens with long curved mauve filaments and small dark purple anthers; median stamen with a shorter filament and a larger anther the cells of which are curved and diverge below. Ovary finely tubercled, greenish; style sigmoidly curved so that the stigma stands out in front of the stamens, as long as the longer stamens, blue.

The dark red or brownish attachments of the lobes of the staminodes appear to be characteristic.

Sequence of Flowering.

The flowers on the inner cyme usually have only a vestigial ovary with no style and fall off after flowering, but occasionally the pistil is fully developed and a capsule may be found. On the outer cyme the first flowers to open have fully developed pistils but subsequent ones have ovaries with variously reduced styles and the last often has only a vestigial ovary with little or no style. Sixteen spathes of plants growing on the Billigirirangan Hills at 5,000 ft. in May were marked. On the first day of flowering 9 had a perfect flower on the outer cyme branch and a male flower on the inner branch, 6 had a perfect flower on the outer branch only, and 1 had a male on the inner branch only. Throughout their flowering 3 spathes matured no flower on the inner branch, 8 produced only 1, 4 produced 2 and 1 had 3. All these flowers were male (vestigial ovary). There was always an interval of at least one day without a flower between the opening of successive flowers on the inner branch, sometimes the interval was 2 or 3 days. On the outer cyme branch the first flower was always perfect. After an interval of one day a second perfect flower opened. Some spathes produced four perfect flowers with intervals of one or two days between successive flowers. More usually after two complete flowers had been produced subsequent flowers had pistils with short styles, or mere vestigial pistils. In a few cases there were intervals of three or four days between successive flowers. Up to three capsules may mature on the outer branch. From flowering to shedding of seed varied between 22 and 28 days.

Some observations were made on plants growing at Kalhatti, Nilgiris (6,500 ft.) and flowering in June. In each case there was first a perfect flower on the outer cyme branch. On the same day, the next day or after an interval of one day, there was a flower on the inner branch. In a number of cases this was perfect, but more often it had an undeveloped pistil. Several successive perfect flowers were then opened on the outer branch, the average interval between successive flowers being 3 days. A capsule was matured on the inner cyme branch in several cases. It is seen that at higher elevations the interval between successive flowers is a little greater. This is probably a temperature effect.

Self-fertilisation.

In this species the filaments of all three stamens and the style coil. The filaments of the staminodes bend and they become involved with the coiling together of the stamens and style, but they do not usually coil. The petals in shrivelling close over the contorted stamens and style. The coiling usually begins about midday.

Capsule and Seed.

Capsule oblong, tip cuspidate, glabrous, straw-coloured, 2-celled, 2-valved, one valve deciduous, both cells 2-seeded. Seeds ovoid-oblong, slightly compressed, about 3 mm. long, dull brownish-black, reticulately pitted and with finer reticulations in the pits, with a ridge along one flattened face (hilum); and a round pit with a central point on the edge (micropyle).

Occurrence and habit.

F.M.P. gives for this species 'In all districts; sea-level to 7,000 ft. Flowers lilac.' The writer has found it to be the common commelina of the hills at 4-7,000 ft.—Kotagiri, Ootacamund Downs, Kalhatti (Nilgiris), Atikan, Dupabarri (Biligirirangan Hills), Palaar, Karankulam (Travancore High Shevaroys). Plants collected in Coorg and the Bababudans also appear to be this species. It has not been found on the plains of the East Coast Districts. It is similar to *C. nudiflora* which is common on the plains, and without mature capsules the two plants may easily be mistaken for one another. The flowers of all specimens seen were definitely blue.

Plants from different localities and situations vary in leaf shape from linear-lanceolate to narrowly ovate and there is also a considerable variation in hairiness, in length of peduncle and pedicel, in breadth of spathe, in number of flowers on the outer cyme and in the development of the ovary of the flowers of the inner cyme, but there do not appear to be very distinct forms.

In an abnormal plant growing at Kalhatti the spathe was large and leaflike and there was a second spathe below the flowers of the inner cyme branch. This suggests that the peduncle and the inner cyme branch are in origin parts of a scape, the spathe being a bract. This may indicate that the genus *Commelina* evolved from *Aneilema* or some other genus in which there is a cymose inflorescence with foliaceous bracts.

The roots in this species are very slenderly tuberous, clothed with a felt of old root hairs, and the bases of the stems are thickened as in *C. kurzii,* but much less so. No starch was present when the root was examined.

Commelina tricolor E. Barnes sp. nov.

C. persicariaefoliae (Wight) affinis sed foliis minoribus angustatis sessilibus utrinque coriaceis, spathe acuminata, petalis magnis differt.

A tufted or straggling herb, probably perennial. Roots slenderly tuberous; tubers up to 5 cms. long, tapering at both ends, about .65 cm. diameter at the middle, white and pubescent when young, dark chocolate-brown when mature. Stems freely branching, up to 50 cms. long, rather slender, 2.5-3.0 mm. dia., cylindrical, slightly flattened on one side, pubescent on the flattened side, otherwise glabrous, darkish red, finely striated with green lines or spots, thickened at the base and forming a clump. Leaves narrowly oblong-lanceolate, up to 1.3 cms. wide and 7.5 cms. long, tapering to a rather blunt tip, base semi-amplexicaul, margin white or red and very finely toothed, upper surface glabrous and with very minute scattered hairs, under surface paler, glabrous, midrib depressed above, raised below, 2 or 3 pairs of more prominent nerves, often 2 on one side and 3 on the other; sheath up to 1.2 cms. long, darkish red, striated or mottled green, glabrous except for a line of pubescence down the side opposite the blade, mouth ciliate, eventually splitting along the line of pubescence. Peduncles solitary, leaf-opposed, rather stout, red or green, glabrous except for a line of pubescence often present along the inner side, up to 5 cms. long. Spathe cordate, tapering to an acute tip, up to 3.8 cms. long and 2.5 cms. wide (opened out), the two halves folded together, sometimes slightly joined at the base, inner surface glabrous, outer glabrous or with extremely short hairs, margins red or white and finely ciliate, watery mucilage present during flowering. Inner cyme branch up to 2 cms. long. usually 1-sometimes 2-flowered, outer cyme branch up to 1 cm. long, 5- or 6-flowered. Posterior sepal boat-shaped with one stronger and 2 weaker nerves; anterior sepals large, broadly ovate, concave, fused together for 1/3 to 2/3 of their length, whitish with 3 pale green nerves. Posterior petals orbicular-reniform, unequal-sided at base, margin often irregular, about 1 cm. dia., claws rather broad, bright blue; anterior petal reniform or deltoid, about .6 cm. dia., margin irregularly toothed, tip bluntly triangular, claw short, pale blue, contained by the anterior sepals. Lateral stamens with long curved white or mauve filaments and small brownish anthers; median stamen with a straight filament about half as long as those of the lateral stamens, anther large and broad, yellow, brownish on the back, the cells curved. Staminodes 3, filaments about as long as the median stamen, heads large, sulphur-yellow, with 4 pouch-like lobes arranged in pairs and usually with a smaller lobe between the pairs. Ovary green, papilose; style straight below but standing at an angle so that the curved upper end and the stigma are in front of the stamens. Capsule ovoid-oblong, somewhat compressed, apex rounded or slightly retuse, about 1 cm. long, glabrous, 2-celled, 2-valves, 4-seeded, both valves remaining attached to the peduncle on dehiscence. Seeds ovoid-oblong, slightly compressed, truncate at one end, 3.5 x 2.2 mm., surface smooth, pale brown, often with a white deposit, a longitudinal brown scar on one face (hilum), and a round pit with a central point on one edge (micropyle).

On Karadimalai and a neighbouring spur, Gudalur Ghat, Nilgiris 4,500-4,700 ft. between rocks and amongst coarse grass. Flowers in July and August and probably during the rest of year as this area receives both the S.W. and the N.E. monsoon rains. Sheets Nos. 2265, 2310, 2311 in the writer's herbarium.

Sequence of Flowering.

Several plants were grown under observation at about 6,500 ft. on the Nilgiris. The flowers on the inner cyme branch are almost always male, having only a vestigial ovary with no style. A flower on the inner branch is usually the first to open and this is followed by a perfect flower on the outer branch. With 9 spathes, the perfect flower opened on the same day as the male on the inner branch in 2 cases, on the next day in 2 cases, after an interval of one day in 4 cases, and after 2 days' interval in 1 case. Subsequent flowers on the outer branch had variously reduced pistils or were perfect, depending on whether a capsule or capsules had been set or not. The intervals between consecutive flowers on the outer cyme branch were:—in 1 case 2 days, in 4 cases 3 days, in 8 cases 4 days, in 3 cases 5 days and in 2 cases 6 days. Sometimes two capsules are formed in a spathe, but usually there is only one and often none.

Spathes are usually at the end nodes of branches but other spathes may form later at the next lower nodes. A few specimens are found which have stiff white hairs on the outer surface of the spathe, on the upper side of the leaf and on the sheath and peduncle.

The rather large whitish anterior sepals and the large bright yellow staminode heads are characteristic. These with the bright blue petals and the red stems make this a striking plant.

Commelina attenuata Koen.

Spathe and Flower.

Spathes ovate-lanceolate 2.5 cms. long, the two halves folded together, base produced into two rounded auricles, tip bluntly acuminate, outer surface and margin glabrous, inner surface with small stiff white hairs except near the centre, central area pale and translucent, mucilage absent. Peduncle slender, about 2 cms. long, bent at the upper end, with fine white hairs along the inner side.

Posterior sepal broadly boat-shaped, base truncate; anterior sepals ovate, concave, joined for about 2/3 of their length, white, translucent with obscure green veins. Posterior petals orbicular-reniform, 6-7 mm. across, base shallowly cordate, claws straight, rather narrow, about 1/3 the length of the lobe, at about right angles to one another; anterior petal standing within the concave anterior sepals, broadly ovate, margin irregular, tip bluntly triangular, base cordate or slightly auricled, claw short and broad; all pale to deep blue. Lateral stamens with mauve filaments curved at the upper end, anthers yellow, broad, cells separated at base for about 1/3 of their length; median stamen with a slightly shortened filament, anther about twice as large as in lateral stamens, cells slightly curved and diverging at base. Pollen grains ovoid, slightly flattend on one side, .05 x .08 mm., surface spinulose. Three staminodes with filaments slender, straight, blue, a little more than half as long as the lateral stamens; heads with 2 larger, 2 smaller and usually 2 obscure round yellow lobes. Ovary green, papilose; style straight, inclined forwards.

Sequence of Flowering.

There are two cyme branches in the spathe. The inner is usually 1-flowered, sometimes 2-flowered; the outer may have 4 flowers. The inner cyme branch and the pedicels it bears are long so that the flowers stand far out of the spathe. On the first day of flowering there is usually a male flower on the inner cyme and a perfect flower on the outer cyme, or there may be a male flower on the inner cyme followed by a perfect flower on the outer cyme the next day. After an interval of 2, 3 or less frequently 4 days, another flower opens; this is usually a second perfect flower on the outer cyme, but it may be a flower with a short style; in a few cases it is a second male on the inner cyme. After a second interval of 2 or 3 days there may be a third flower on the outer cyme which is sometimes perfect but more often has an aborted pistil.

As the removal of the earlier flowers from the outer cyme is found to cause the later flowers on that cyme to become perfect, it was thought that possibly the complete removal of the outer cyme might cause the flowers of the inner cyme to become perfect. In eight developing spathes the outer cyme branch was carefully cut out while it was in small bud (3-5 days before the first flower was due to open). In each case when the flower of the inner cyme branch opened it was found to be male, the vestigial ovary showing no sign of development.

Self-fertilisation.

The filaments of the lateral stamens and the style coil together. The filament of the median stamen arches at the upper end. The staminodes do not coil. The lateral stamens of the male flowers coil. Self-fertilisation is usually successful.

Capsule and Seed.

Capsule ovoid-oblong, apex truncate, surface smooth, 2-celled, 2-valved, 4-seeded. Both valves remain attached to the pedicel after dehiscence, and the dry spathe remains attached to the plant. There is usually one capsule each spathe, sometimes two.

Seed barrel-shaped, 4 m.m. long. ashy or pale brown speckled with black, a roundish cap at each end which is more or less gelatinous when the seed is first shed but on drying becomes white and honey-combed with round holes. Hilum a longitudinal brown line; micropyle a pale oval patch.

Occurrence.

This plant is common in grassy places on the plains of the East Coast districts and up to about 4,000 ft. on the drier slopes of the hills (Billigirirangans) and in S. Travancore (Udayagiri). It appears to be able to tolerate saline conditions as it is found on the seashore sands and round the salt pans at Covelong. The stems are prostrate and rooting occurs at each node if conditions are favourable. The roots are long and fibrous, and the plant appears to be an annual. It flowers during the moister months and dries off about March.

Commelina benghalensis Linn.

Spathe and Flower.

Spathe rather narrowly funnel-shaped, compressed, inner angle obtuse, outer acute, very shortly peduncled, outer surface with long jointed tapering hairs and numerous shorter jointed hairs with hooked tips, inner surface glabrous, mucilage present, solitary, usually leaf-opposed at the end node of a stem or branchlet. There are often a number of slender branchlets bearing several spathes one at each node opposite a small leaf.

Posterior sepal broadly boat-shaped, concave, tip green, inturned; anterior sepals obovate-orbicular, concave, joined for a short distance above the base, whitish with a median green vein. Posterior petals reniform-deltoid, unequal sided at base, 6.5 mm. across, claw rather broad about as long as as the lobe; anterior petal ovate, tip triangular, turned in, claw short and broad; all dark blue. Lateral stamens 2; filaments blue, slightly curved at upper end; anthers small, dark blue, attached near the base; median stamen with slightly shorter filament; anther larger, yellow, cells curved and diverging. Pollen of the lateral stamens white, of the median stamen yellow, grains ovoid, ends buntly pointed, .035-.04 x .015 mm., with a longitudinal groove, surface glossy, apparently with minute pits. Staminodes 3; filaments very slender, colourless, $\frac{1}{2}$-$\frac{3}{4}$ as long as the stamens; heads pale yellow with 4 larger and 2 smaller lobes. Ovary 3-lobed, pale green, style a little longer than the lateral stamens, upper end purple.

Sequence of Flowering.

There may be two cyme branches in the spathe but the inner is sometimes suppressed. In most cases there is a male flower on the inner branch and a perfect flower on the outer branch on the first day of flowering. Then on the next day or the day after there is a second perfect flower on the outer cyme, and there may be a third on the following day. Of 33 spathes that first opened a male flower on the inner and a perfect flower on the outer branch, 20 opened a second perfect flower on the outer branch next day, and 11 on the day after.

Self-fertilisation.

The filaments of the style and lateral and median stamens coil strongly at their upper ends. The style stands between the stamens, and the stigma is often in contact with the anthers of the lateral stamens before coiling has set in. The filaments of the staminodes do not coil. Self-fertilisation appears to take place very frequently, and to be successful. Of 18 spathes examined, 10 had 3 capsules, 5 had 2 and 3 had 1. In 24 capsules examined 22 had 5 seeds and 2 had 4 seeds.

Capsule and Seeds.

Capsules broadly ovoid-oblong, gibbous on the back and obscurely keeled, surface sub-glossy, very finely longitudinally furrowed, tip truncate, 2-valved, 3-celled, 2 cells 2-seeded, posticous cell indehiscent and 1-seeded. From flowering till the dehiscence of the capsule varied from 15 to 18 days (January and February), average about 17 days. When the capsule is about to dehisce the spathe turns yellowish and becomes detached from the plant. By means of the small hooked hairs on its outer surface the spathe will cling to a hairy surface and is no doubt often carried about by animals on their fur. The mouth of the spathe remains closed at first and the smaller seeds of the anticous cells are retained for some time owing to their rough surface. The posticous valve containing the indehiscent 1-seeded cell easily becomes detached from its pedicel, but owing to the wing-like portions of the anticous cells attached to it on each side, it is usually held in the spathe. The anticous valve remains attached to the pedicel.

Seeds of the anticous cells ovoid, one end truncate, the other rounded, 2 mm. long, flattened on one side, dull grey, minutely speckled with white, with irregular transverse ridges, a round depression with a central point on one edge (micropyle), an obscure longitudinal line on the flattened face (hilum). The minute white speckles are seen under the microscope to be more or less spherical excrescences.

Seed of the posticous cell ovoid, 3-3.5 mm. long, one side flattened, both ends rounded, a brown ridge on the flattened side (hilum), a roundish pit on one edge with a central point (micropyle), convex side about 7 ridges radiating from the micropyle.

The smaller seeds of the anticous cells germinate much more slowly than the larger ones of the posticous cell. Twelve seeds of each kind from the same capsules were placed on wet sand (February—early March); the larger seeds took 18, 19 and 21 days to germinate, and after 21 days no more seeds germinated; the smaller seeds germinated after 27, 32, 44, 49, 51, 64 days.

Cleistogamous Flowers.

This species produces cleistogamous flowers. In these the spathe is pear-shaped, one edge of the margin being folded over the other (right over left or left over right on the same plant). The outer angle is thus made into a point which may be useful in penetrating the soil. It is cream-coloured and covered with small hooked hairs on the outside; no mucilage is present. There is a single flower on a short jointed stalk. The petals are small and blue and do not expand, but remain enclosed by the sepals. There are three staminodes whose filaments are not coiled. The 2 lateral and the median stamen have their filaments coiled at the upper end and all yield pollen. The style is also coiled, and purple. The white underground runners bearing the cleistogamous spathes may be up to 20 cms. long. may have

6 nodes and may bear 3 or 4 spathes (one at a node). Three underground runners, a branch and 2 roots may originate at the same node of the stem.

There is every stage between normal spathes and cleistogamous ones—spathe green, 1-5 cms. long, opposite a large leaf, second spathe, above this, on a short shoot with a small green sheath opposite to a smaller spathe—shorter green slender branches bearing 2 or 3 smaller and narrower spathes each at a node and with a green-veined prophyllum opposite the spathe and a scarious prophyllum between the spathe and the axis. The prophyllums are like sheaths without the green blade but with a rounded end with a blunt apiculus, striated green with whitish transparent spaces between—slender downward pointing green branches with still smaller spathes and tips of petals separate—runners partly under the soil, the upper part only green.

Distribution and Habit.

This species is said to occur in all districts except the wettest (F.M.P.), but it has been collected by the writer on the Nilambur Ghat, which has a very heavy rainfall (about 150 inches). It occurs also on the Billigirirangan Hills at 4,000 ft., on the Elagiri Hills and in the Ouchterlony Valley (Nilgiris) about 4,500 ft.)

The leaves vary to some extent in different localities; normal leaves, especially on their under-surface, have curved and some hooked hairs, and will cling to a woolly surface. The stems also have fine hooked hairs.

Commelina jacobii C. E. C. Fischer.

Spathe and Flower.

Spathes broadly ovate to almost orbicular (opened out), up to 2 cms. long and broad, base shallowly cordate, apex blunt or sub-acute, two halves folded together, each half strongly convex, margins closely approximated and fused together for a short distance above the base, four pairs of prominent nerves arching from base to apex, inner surface glabrous, outer covered with short hooked hairs; mucilage present during flowering; peduncle up to 1.5 cms. long solitary, leaf-opposed. When the spathe is at the end of a branch it is usually opposite to a small orbicular leaf about 1 cm. long.

Posterior sepal broadly boat-shaped, apex incurved; two anterior sepals broadly ovate, concave, not joined together, transparent. Two posterior petals with semi-circular lobes 7-8 mm. dia., outer sides cordate at base, inner truncate, claws long and narrow; anterior petal broadly ovate, tip bluntly triangular, margin with 2 blunt teeth on each side, bright blue. Two lateral stamens with long slender filaments and small yellow anthers notched at base; median stamen with shorter straight filament and larger yellow anther with curved cells; pollen yellow, grains ovoid, slightly curved, one side flattened, .08 x .04 mm., surface finely and densely spinulose. Staminodes 3, sometimes only 2, filaments ½ to 2/3 as long as the longer stamens; heads bright yellow with 2 larger broad and 2 smaller narrow lobes arranged like the wings of a butterfly, 2 very small lobes often present between them. Ovary green, immersed in mucilage; style purple, as long as the longer stamens, curved so that the stigma stands in front of the stamens.

Sequence of Flowering.

In this species only the outer branch of the cyme is fertile; the inner branch is slender, only a few mm. long and with a gelatinous tip. Twenty-nine spathes of plants from the Gingee Hills grown at Tambaram were marked (August). Each first produced a perfect flower. Eleven spathes had no second flower. Ten had a second perfect flower on the following day, and 4 after an interval of 1 day. The second flower in four spathes had an imperfect pistil (style short and coiled), two on the next day and two after an interval of one day. One spathe had three complete flowers on successive days. It was noticed that as a plant grew older its spathes more frequently had only one flower.

A plant of this species found on the Elagiri Hills at about 2,000 ft. was grown at Tambaram and flowered in March. Of twelve marked spathes, ten first produced a perfect flower, and two had perfect flowers on the outer cyme branch open together. This is very rarely observed. Of these twelve spathes

8 had no subsequent flower; 3 had a second complete flower on the next day, and one had an imperfect flower after an interval of a day.

From the opening of the flower to the dehiscence of the capsule is about three weeks.

Self-fertilisation.

The filaments of the two lateral stamens and the style coil together. The median stamen and the staminodes do not coil, but they may become involved in the coiling of the style and lateral stamens. Self-fertilisation appears to be effective.

Capsule and Seed.

In the small form from the Elagiris grown under observation at Tambaram, only one capsule was formed in a spathe. Spathes of the large form found at Kallar (Nilgiris) had up to three capsules .85 cm. long. Capsule oblong, 3-celled, 2-valved, 5-seeded when fully developed. The posticous valve deciduous, containing the 1-seeded indehiscent cell; the other two cells each containing two seeds which fall out when dehiscence occurs. After dehiscence the sutures of the valves are seen to be strongly wavy. The outer surface of the deciduous valve is yellowish-brown and completely covered with fine longitudinal wavy ridges; it has also an obscure longitudinal keel. Seed of dehiscent cells ovoid oblong, slightly flattened and curved, 4-4.5 mm. long, 2.5 mm. broad, pale pinkish-brown with black markings, one face with a curved black slit (hilum), the other with a pit containing a small conical projection (micropyle), the convex edge with 3 transverse tubercled ridges; seed of the indehiscent cell with about 5 radiating ridges which can be seen as undulations on the surface of the cell. The spathe becomes detached soon after the capsule opens, but its margins remain pressed together. It clings to hairy surfaces by the hooked hairs with which it is covered and is probably carried about by animals. The seeds because of their tubercled ridges, and the one-seeded valve because of its wings and rough outer surface are held in the spathe and are thus dispersed.

Occurrence.

This plant was found at Coimbatore and in the Salem District by Mr K. C. Jacob. It has been found by the writer along a stream on the slopes of the Elagiri Hills, North Arcot District, at about 2,000 ft. flowering in December, on the Gingee Hills, South Arcot District, and at Kallar, Nilgiri District, at 1,700 ft. (mature capsules July). The Kallar plant was a large form with stout stems and leaves up to 10 cms. long and 4 cms. broad, the apex acuminate. The spathe with its two convex halves having their margins pressed together, and the very characteristic capsule and seed enable this species to be identified with ease. The roots are slender and yellowish. Rooting occurs at the lower nodes. The plant is able to carry on from year to year if conditions are favourable.

Commelina forskalaei Vahl.

Spathe and Flower.

Spathe irregularly funnel-shaped, compressed, outer angle acute, inner rounded, up to about 1.4 cms. long, with 3 prominent pairs of nerves, inner surface glossy, outer covered with very short hairs and the basal half with numerous long stiff tapering colourless hairs, margin often red; peduncle shorter than the spathe. Mucilage is present during flowering. Cyme branches pubescent.

Posterior sepal broadly boat-shaped; 2 anterior sepals ovate, concave, tinged blue. Posterior petal orbicular-cordate, unequal-sided, 8 mm. dia., claws narrow and at about right angles; anterior petal lanceolate, concave, shorter than the sepals between which it stands; all petals deep blue, veins darker. Staminodes about ¼ the length of the lateral stamens, filaments slender, heads usually with four narrow yellow lobes arranged like a cross but one or more lobes often lacking. Lateral stamens with long thick deep blue curved filaments, the upper halves of which are flattened and broadened; anthers narrow, greenish-blue. Median stamen with a shorter filament not dilated above; anther large, greenish-blue, the cells curled above, diverging below and with yellow auricles at the lower ends. Ovary glabrous, style blue, curved forward. Vestigial ovary present in male flowers. The broad flattened upper parts of the anthers of the lateral stamens are distinctive.

Sequence of Flowering.

In this species the inner cyme branch is usually one-flowered, occasionally barren; the outer branch has 3 to 5 flower buds. On the first day of flowering there is usually a perfect flower on the outer branch and a male flower on the inner. Much less frequently there is a complete flower on the outer branch followed next day by a male on the inner. In spathes that first opened two flowers simultaneously there was in 7 out of 10 cases an interval of two days before another flower opened, and in 3 an interval of one day. If the first complete flower on the outer branch has set a capsule, the second flower has a small ovary with a short coiled style; if a capsule has not been set the second flower is perfect. Usually only one capsule is formed in each spathe. The single male flower on the inner cyme branch drops after flowering.

Self-fertilisation.

The two lateral stamens coil outwards. The median stamen bends but does not coil. The style coils and the stigma is generally brought into contact with the anther of the median stamen. The staminodes do not coil. The lateral stamens coil in male flowers. Self-fertilisation appears to be successful.

Capsule and Seed.

Capsule sub-cubic, buff-coloured, 3-celled, 2-valved. The posticous valve is deciduous and contains the one-seeded indehiscent cell. The other two cells are 2-seeded. The outer surface of the indehiscent cell is finely longitudinally furrowed and has a number of narrow wings at the sides. Seeds spherical, compressed, about 3 mm. dia., yellowish-brown mottled lighter, surface smooth, with a blackish groove on one face (hilum).

This plant is very common in grassy places near Coimbatore. It either runs along the ground rooting at the nodes, or it becomes erect and 20-25 cms. high. It produces underground cleistogamous flowers freely.

Commelina undulata R. Br.

Spathe and Flower.

Spathes irregularly funnel-shaped, compressed, outer angle acute inner rounded, up to 2 cms. long, outer surface covered with short hairs hooked at the tip, and with some long bulbous-based jointed white hairs, inner surface glabrous, musilage present; peduncle up to .5 cm. long, colitary, leaf-opposed, near the ends of branches.

Two anterior sepals broadly ovate, concave. fused together for half their length or less, white with transparent margins; posterior sepal broadly boat-shaped, smaller. Two petals with semi-circular lobes, about 1-1.2 cm. across unequal-sided, standing opposite one another so that the straight sides are parallel, claws rather broad, about 1/3 the length of the lobe; third petal small, narrowly ovate or lanceolate, shorter than the two larger sepals between which it stands; all bright blue. Staminodes three, similar, with slender filaments about half as long as that of the median stamen and with yellow six-lobed heads, 2 lobes roundish, 2 elongated and diverging and 2 very small. Two lateral stamens with long blue flattened filaments bent like calipers, anthers small, dark blue, the cells separated below the attachment; median stamen with a shorter tapering anther much larger, yellow margined bluish-green, the two cells much curved above and strongly diverging below, each with a yellow upturned auricle at the base. Pollen almost white; grains ovoid-oblong, .07 x .045-.05 mm., the surface densely and finely spinulose. Ovary green, style blue, sigmoidly curved so that the stigma stands in front of the anthers.

The two semi-circular blue lobes of the posterior petals standing with their straight sides parallel, and the yellow auricles at the bases of the cells of the anther of the median stamen are characteristic features of the flower.

Sequence of Flowering.

In this species only the outer branch of the cyme is developed, the inner being aborted to a flowerless axis about 1 mm. long. The outer cyme branch rarely bears more than four flowers. Thirty-five spathes of plants growing at Tambaram were marked (Dec.-April). In each case the first flower to open was perfect. In 25 cases the second flower was also perfect and in ten the pistil was incompletely developed. Twenty of these second flowers opened after an interval of 1 day, 12 after 2 days, and 3 after 3 days. A third flower opened in 23 spathes, and of these only 3 were perfect, the rest having infertile pistils. One of these opened on the next day to the second flower, 15 after an interval of 1 day, 6 after 2 days and 1 after 3 days. Only 9 spathes produced a fourth flower, and all of these were male; 6 after an interval of 1 day, 3 after 2 days and 1 after 3 days. It was found that almost invariably an imperfect flower indicated the presence of a capsule in the spathe from a previous flower. Imperfect flowers have longer pedicels and so stand further out of the spathe than perfect ones. Male or imperfect flowers have all three stamens fertile but the pistil reduced to a small ovary with a short usually coiled style, or the ovary may be almost completely absent.

Self-fertilisation.

In perfect flowers the filaments of the lateral stamens coil and the style coils; the filament of the median stamen arches at its upper end so that its anther is bent down and may become involved in the coiling of the style; the filaments of the staminodes do not coil. The lateral stamens coil in male flowers. Self-fertilisation is successful.

Capsule and Seed.

Usually one capsule matures in each spathe but sometimes there are two. Capsule broader than long, 3-lobed, apex truncate, surface smooth, buff, 3-celled and 3-valved, there being one seed in each cell when fully developed, the 3 valves remaining attached to the pedicel. Seeds almost spherical, dark grey or black with lighter mottling, surface slightly roughened, a narrow brown groove (hilum) on a slightly flattened face and a raised blistery band almost encircling the seed; a pit with a point between the ends of the band (micropyle). From opening of flower to dehiscence of capsule varies from 17 to 24 days. The spathe becomes detached from the plant when the capsule dehisces. The small hairs on the outer surface of the spathe enable it to cling to hairy or woolly surfaces and it is probable that animals thus help to distribute the seeds.

Occurrence and Habit.

There are at least two forms of this species. The commonest is prostrate and occurs in open grassy places on the plains in the eastern districts (Chingleput, Nellore) and in cracks in rocks on dry hillsides up to 4,000 ft. (Billigirirangan Hills).

This form is tufted and the stems are usually short and rest on the ground. The bases of the stems are swollen and united into a clump. At first the condensed lowest internode of each stem is top-shaped, but later the second internode also thickens and an oblong corm-like body about 1.3 cms. long and up to 1 cm. across is formed. These bodies persist after the upper parts of the stems have dried off. Fresh stems originate from buds at the bases of these bodies, and eventually a large clump is formed. The material of these stem bases is firm and white and consists largely of starch. These bodies no doubt function as corms and enable the plant to survive through the dry season. From the under side of these corm-like bodies there are long slender tuberous roots. These roots are cylindrical, about .35 cm. across near the top, and taper gradually downwards. The flesh is succulent and in the older roots the core contains starch. The surface of these roots is covered with a dark brown felty covering. At first it was thought that this felty layer might indicate the formation of a mycorrhiza but microscopic examination shows it to consist of numerous dried root-hairs.

Rooting does not occur at most nodes but in favourable conditions some of the nodes near the ends of the stems may root, especially if there are side branches from these nodes. After rooting the bases of the side branches thicken and a tuft is formed, which may then develop into an independent plant.

This plant is perennial and will stand hot dry conditions better than any other South Indian commelina. It may be found flowering freely in exposed places till late in April, some weeks after the grasses and other herbaceous plants have dried off. The flowers open at sunrise, earlier than other species. It has rather thick narrow leaves, the two halves partly folded together.

A second form occurs in the same districts but is found in the shade of thickets. It is first erect and when the stems get long they straggle over shrubs and may become 6 ft. in length. It has thinner, rather broader and flatter leaves. It does not flower freely. A similar plant was found at about 3,000 ft. at the foot of the Sigur Ghat, Nilgiris. The tall form also has enlarged stem bases.

Commelina kurzii Clarke.

Spaths and Flower.

Spathes clustered at the ends of the branches where there may appear to be up to about seven spathes at a node. Examination shows that there are two or more nodes very close together, each with one spathe opposite a leaf, and often the end of the branch is shortly bifurcated, each part having several condensed nodes. There are also short scarious triangular cataphylls at these nodes. Spathe irregularly funnel-shaped, the two sides folded together, outer angle acute and acuminate, inner rounded, 2-2·5 cms. long, outer surface with long scattered hairs and many short hairs hooked at their tips; peduncle up to about ·5 cm. long.

Posterior sepal small, broadly boat-shaped; two anterior sepals broadly ovate, concave, fused together for ½ to 2/3 of their length; all colourless. Two posterior petals with approximately circular lobes unequal-sided at the base, up to 1 cm. in dia., claws narrow, straight, standing at a little less than right angles to one another, mauve; anterior petal lanceolate, only about as long as the claws of the others; tip acuminate and curled in, colorless. Two lateral stamens with long arching filaments and small anthers; median stamen with shorter and stouter filament, anther large, yellow, with curved cells diverging below, each cell having a flat yellow auricle above its base. Pollen cream-coloured, grains ovoid-oblong, ·08-·09 x ·04 mm., surface finely spinulose. Staminodes 3, filaments slender about 1/3 as long as lateral stamens, heads yellow with four larger pouch-shaped lobes and two smaller ones. Style about as long as the lateral stamens, curved forward so that the stigma stands in front of the samens; ovary green, smooth, immersed in mucilage.

Sequence of Flowering.

The spathes on the same branch form successively. Normally only the outer branch of the cyme develops, or inner being represented by a bud at the base of the spathe; very rarely the bud develops to a long pedicelled male flower which opens with the first flower of the outer cyme. The spathe of the Vandalur form contains mucilage during the flowernig period, but this is not so with the Sigur Ghat form. During December and January, 21 spathes of the Vandalur form of this species were marked. The first flower produced by each spathe was perfect. In two spathes the second flower opened after an interval of 1 day, in 2 after 2 days, in 13 after 3 days, in 3 after 4 days and in 1 after 5 days. Three of the second flowers were perfect, and 18 had the pistil incompletely developed but the stamens normal. Only 3 spathes produced a third flower, and all of these had imperfect pistils. These flowers opened after intervals of 3, 4 and 5 days. It was thought that the incomplete development of the pistil in the second or third flower of a cyme might be conditioned by the presence of a developing capsule from an earlier flower. Experiment showed this to be the case. Eleven spathes, each with a perfect flower, the first on its cyme, were marked, and each of these open flowers was cut off without damaging the rest of the cyme. In each case the second flower was perfect. The interval between flowering was reduced by the removal of the open flower. One of these spathes opened its second flower the next day, 7 after an interval of one day, 1 after 2 days, 1 after 3 days and 1 after 4 days. Four of these spathes subsequently produced a third flower, each of which was imperfect. It was also found that if the first and second flowers were cut off when they opened, the third flower became perfect. Further, four spathes in which the first flower had formed a capsule and the second flower was imperfect, had the capsule and imperfect flower cut off. After an interval of two days three of these spathes produced a perfect flower, and the fourth did so on the following day. Imperfect flowers have longer pedicels than perfect ones and stand further out of the spathe.

The flowering of narrow-leafed form of *C. kurzil* brought from the Billigirirangan Hills and grown at Tambaram was a little different from that of the Vandalur form. In October it began to flower and 16 spathes were marked. Each first produced a perfect flower. Five produced a second flower after an interval of 1 day, 9 after 2 days, and 2 after 3 days. Seven second flowers were perfect, and 9 had the pistil undeveloped to various degrees. Thirteen spathes had a third flower, 2 of which were perfect, and 4 had fourth flowers, all of which were incomplete.

The form of this species with larger leaves and thicker stems occurring on the Gingee Hills flowered in August. Three first flowers were perfect; two second had undeveloped pistils and opened after an interval of one day, and one second had undeveloped pistils and opened after an interval of one day, and one second was perfect and opened the next day and was followed by an incomplete flower.

The Sigur Ghat form was grown at Kalhatti (about 1,500 ft. above its habitat). First, second and third flowers were all perfect. The intervals between successive flowers varied from 2 to 5 days, averaging about 3 days.

Self-fertilisation.

In this species the filaments of the two lateral stamens and the style coil before the flowering is over. The filament of the median stamen bends at its upper end but does not coil. First the filaments of the lateral stamens arch inwards so that the pollen-bearing surfaces of the anthers face inwards and approach the large anther of the median stamen. The style then curves and the stigma is usually brought into contact either with the anther of the median stamen or with one of the lateral ones. Often the style subsequently coils round the large anther of the median stamen, whose shape appears to be specially adapted to receive the coiling style. Subsequent coiling of the lateral stamens may again bring their anthers in contact with the stigma. The time of coiling is of course affected by temperature, exposure and other external factors. At Tambaram in April, it was found that by 10 a.m. the style had made one complete coil and had often encircled the large anther. The filaments of the lateral stamens had at this time become strongly arched. By 11 a.m. the lateral stamens had completed one coil, and by noon they had completed two or three coils, and the style, if not obstructed, had formed three coils. Eventually the style and the lateral stamens are usually coiled together round the anther of the median stamen. The filaments of the lateral stamens coil even in flowers with undeveloped pistils, and the coiling occurs rather earlier. When the filaments of perfect flowers had made one coil, those of imperfect flowers were found to have made two. The filaments of the staminodes do not coil. In the Sigur Ghat form grown at Kalhatti (6,600 ft.) the coiling did not begin till after midday, and was not complete till after 3 p.m. The mechanism for self-fertilisation is very effective.

Capsule and Seed.

The capsule in 3-seeded and 3-celled and 2-valved. When it opens the posticous valve falls off. This valve contains the indehiscent cell which contains one of the seeds. The convex outer side of this valve is roughened by longitudinal ridges. The other valve remains attached to its pedicel in the spathe but the two seeds fall out. The spathe becomes detached and gapes when the capsule becomes mature. The two free seeds usually fall out of the spathe, but the third, owing to the wings and the rough surface of the valve that contains it, is often held in the spathe. The hooked hairs on the outer surface of the spathe make it liable to be carried by animals and thus the contained seed is dispersed. Usually only one capsule matures in each spathe. Of 28 fruiting spathes 23 contained only one capsule, and of the other five that contained two capsules, only two had both capsules with all three seeds.

The interval between the opening of the flower and the dehiscence of the capsule appears to depend on temperature; in November and December it varied between 29 and 34 days, and in March it was from 22 to 25 days.

The seeds are broadly ovoid with 2 somewhat flattened adjacent sides, surface dull dark grey covered with minute white grains. There is a brownish scar along the edge between the flattened sides (hilum). A brownish or grey blistery ring almost encircles the seed, and between the two ends of this ring there is a small crater-like depression with a central point (micropyle).

Forms and Occurrence.

This plant grows between rocks from a little above sea-level to about 5,000 ft., under the shade of shrubs or trees in the hotter areas, in open places at higher elevations. There are a number of local forms differing chiefly in habit and leaf shape, but all have similar flowers, spathes and capsules. All forms seen by the writer have mauve petals and not blue as stated in Clarke's Monograph, F.B.I. and F.M.P.

The form found at Vandalur (Chingleput District, 100-200 ft.) has slender trailing stems and broad leaves (up to 10.5 x 2.8 cms. but usually smaller). The Gingee form is similar but more robust and has the outer surface of the deciduous valve of the capsule tubercled and the spathe almost glabrous. A similar plant but with hairy spathes occurs on the Sigur Ghat (Nilgiris) at 4,500 ft. One form found in the Billigirirangan Hills has long narrow leaves (11 x 1.6 cms.) and a trailing habit. A second is like the Gingee form but still more robust (leaves 15 x 4.3 cms. spathes 2.3 cms. across). A third form found on these hills is more or less erect and has broad but acuminate leaves and spathe with acuminate outer angle. A similar plant occurs on the Gudalur Ghat, Nilgiris, and at 5,000 ft. on the Shevaroys. The narrow-leafed form from the Billigirirangan Hills and the broad-leafed Vandalur form when grown under identical conditions at Tambaram for 2 years remained distinct, showing that the differences are not due simply to environment.

This plant roots readily at the nodes if they are in contact with moist earth. Root buds are present at other nodes but they do not develop. The lowest internodes of the stems thicken to small top-shaped bodies which together form a clump. These bodies contain much starch and function as corms enabling the plant to survive the dry season. From these stem-bases numerous slender fleshy roots emerge. They are about 3 mm. across and up to 5 cms. long and contain a good deal of starch in a layer round the centre. The outer surface is covered with a dark brown felt consisting of numerous dried root hairs.

A BIRD PHOTOGRAPHER'S MUSINGS FROM KASHMIR.

BY

LT.-COL. B.T. PHILLIPS.

(*With 8 plates*)

Soon after gaining a little confidence in my newly invented gadgets for 'distant release' bird photography, and pleased at finding they were instrumental in producing unposed and natural results of bird life, I decided to go further afield and spend my two months' leave in Kashmir. I was lucky having June and July at my disposal, though an earlier date might have been more favourable for the purpose. Within a day or so of my arrival in Srinagar I was lucky to find a bird shikari who had been recommended to me as good; with all his shortcomings, a grand old red-beard, Habiba of Shalibug—an expert at birds in and around the lakes and marshes, and a willing henchman to boot.

In spite of the good recommendations received, the usual ceremony of at least pretending to wade through the wad of 'chits' (testimonials), handed you with pride in true 'die-hard' '*Dastur Hai*' (customary) fashion, had to be respected. Habiba was taken on for the period of my stay.

With a very hazy knowledge of the birds that might be met with, and with visions of fresh fields to conquer, it yas pleasing to find at one's disposal a tested guide. The first outing was arranged—a run out to the River Sind at a point only 20 miles from Srinagar. The objective was a photograph of a Common Sandpiper which had a nest with a freshly completed clutch of eggs. A start by car was made early next morning. The drive for the first five miles along the Ganderbal Road, through the crowded city and a network of congested villages, is a corrective to ideas culled of novels, telling of the romance of the East. From this point onwards Nature asserts itself. The country opens out with a panorama showing to the west, Anchar Lake, a broad sheet of water alongside the road, overshadowed in the distance by the snowy Pir Panjal Range; to the east, a broad valley of arable and pasture land gradually rising to a lofty ridge of mountains.

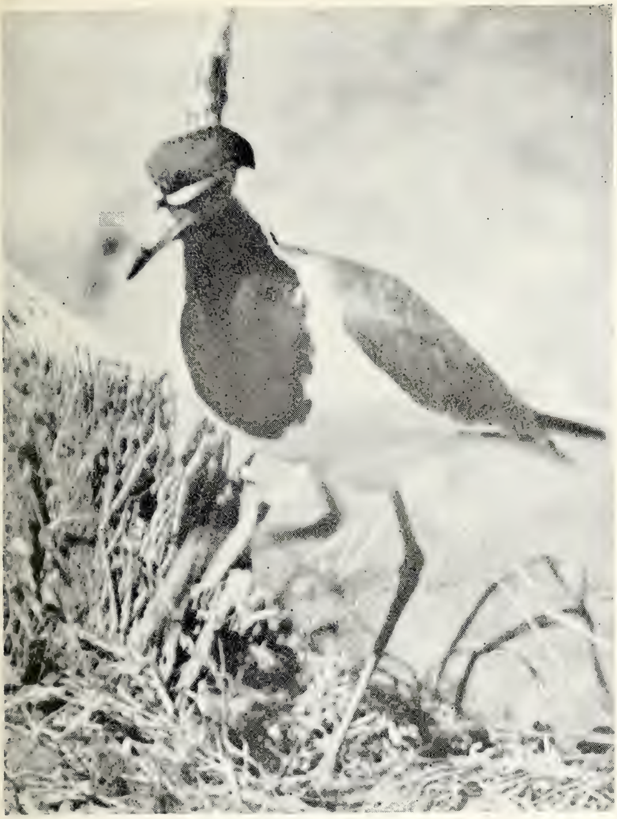
Those ubiquitous townsfolk, the crows, the kites, mynas, and sparrows, though still to be seen, do not intrude with such unfailing familiarity now that the open country is reached, yet there is no diminution in bird life. The avian world appears to be just as busy and affords great variety both in species and vivid colourings. The beloved English Swallow is present and will be seen flying with speed and grace in these open spaces, twittering as it hawks insects over the paddy fields or rests on the telegraph wires by the road.

From a neighbouring post a vision in Oxford and Cambridge blue swoops down to the ground to pick up a cricket or grasshopper and return to its post, or flashing in the sun, it launches itself with harsh, grating screams in fantastic gyrations to display its beauty to the mate of his choice. This is the Kashmir Roller.

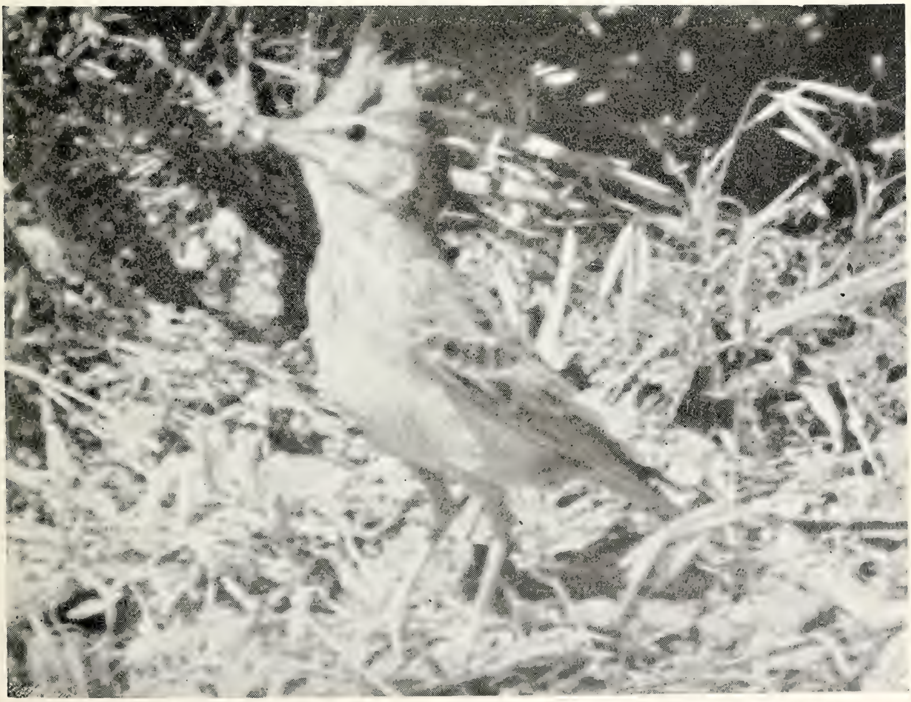
Many others will attract attention but as my main object was to try and get series of photographs of the Sandpiper, still some fifteen miles distant, I tried to keep to the task in hand, but failed. No sooner was the car in motion than I heard fantastic cries of a 'Did-he-do-it' uttered repeatedly, and looking across the fields in that direction saw a bird apparently fiercely attacking a ryot who was crossing some fallow land.

The Red-watted Lapwing *Lobivanellus indicus.*

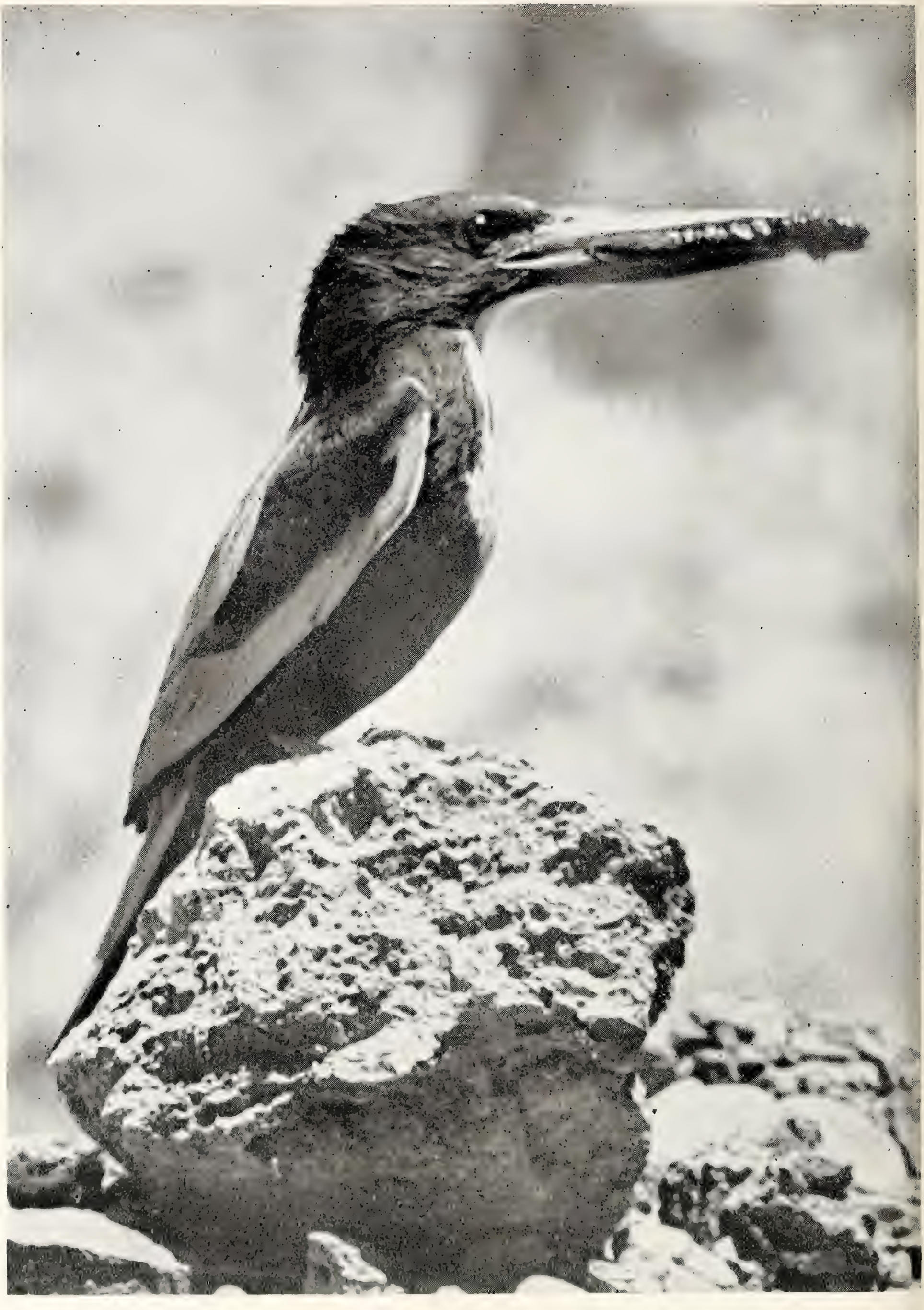
This Lapwing, a bird common round Cantonment areas in the Plains, was known to me, and therefore this persistent behaviour aroused my suspicions. The car was once again brought to a standstill to enable me to watch more closely through binoculars. The birds in view alighted apart, making it difficult to watch both



The Red-wattled Lapwing.



The Kashmir Skylark.



The White-breasted Kingfisher.

of them. Soon it became obvious that one was feeding owing to its bearing,—upright stance, and occasional, typical short spurts to capture stray insects.

My attention was quickly centred on the other bird. It was carefully moving across the field in a crouching attitude and with gliding gait; it must have covered twenty yards or so in this manner before settling down. Five minutes passed, the bird was still sitting. Had a nest been found? Do not let excitement at discovery set one into wild rush for the site. Much caution is necessary. The quarry is wide awake and though the size of a partridge and strikingly coloured, the pattern of the plumage harmonizes well with the surroundings. Slipping away from the nest, while one is still in the distance, it detracts attention from the all-important focal point—the nest, there is nothing to see but a jumble of ploughed land, or an equally confusing stretch of grass. The nest itself does not help one in the search, it is a mere scrape in the ground encircled with small stones or pellets of clay to suit the surroundings, and the eggs, blotched and streaked in black also closely match the site and nesting materials chosen. The ground colour of the eggs may vary with the colours of the soil; it is a stone colour in boulder-strewn areas, a creamy buff in clay and, I have read, even a reddish buff on red lime-stone.

The nest was found and it contained four pear-shaped eggs large for the size of the bird. This caused the first interruption. The camera and apparatus had to be set up.

The birds did not appear to mind the camouflaged 'set up', in fact, I was scarcely given time to reach the switch before the bird would settle down, in spite of the pandemonium created during their feigned attacks on me at each visit to the camera. An obstacle commonly met with in all cases where birds build on flat featureless ground is the difficulty of visualising the pre-focused area. Many good action pictures are thus ruined as the subject is found to be out of focus. Before leaving for home that evening it looked as though further interruptions in the original plan for the day's outing were in the offing. A Skylark, having completed its exuberant song in the heavens, dropped down into the pasture and not far from the sitting Lapwing, and a band of gaudy European Bee-eaters seemed to be attached to a certain reach of a fairly deep-sided nullah, also in view.

The Kashmir Skylark. *Alauda gulgula guttata.*

An early arrival in the area next morning brought back pleasant memories of pastures green and the English South Downs. There were several skylarks hovering in the heavens giving vent to their spirited and joyful song. Now one, now another would drop like a stone with closed wings earthwards, falling lower and lower until it finally settled. Being a bird with inconspicuous striated plumage, no larger than a sparrow it is very difficult to see when on the ground owing to its crouching gait. After two or three attempts at flushing the female bird in the areas indicated by recently grounded males. I was about to resort to the schoolboy trick of trailing over the surface of the field a cord, some twenty yards in length, held at the extremities by my shikari and myself, when a lark sprang up from under my feet and fluttered away. A careful search revealed the nest; a little cup on the ground, lined with fine grass, well screened from view, under a low spreading creeper-like growth. It contained four eggs, their white ground almost entirely concealed by fine brown spots.

The camera was set up and, after much searching, a vantage point gained from which to view the approaches to the nest, but had it not been for a red poppy placed to mark the site, its exact position would have been hard to pick up. Quite a half hour passed without any sign of the bird in this matted area, so an attempt was made to improve the look of the camouflaged camera. To my surprise the sitting bird flew away from the nest! Similarly, on two separate occasions the bird was flushed off the nest without having given any indication of its approach. It would seem that its 'obliterative' plumage, its crouching walk, its squatting was too much for my watchfulness, and so, after a vain three hours of failure, I flattened down a 9-inch wide drive around the nesting site. This ruse succeeded. I was able to snap the bird often on its approaches to the nest, its markings standing out well against the sandy background.

In my ignorance I thought, I had pictures of the Crested Lark, as occasionally an untidy moppish crest became visible. The Crested Lark is easily distinguished by the erect tuft of pointed feathers on the crown. It does not breed in the Vale but takes up its summer quarters on the higher mountain ranges of Ladakh and Central Asia.

The European Bee-eater. *Merops apiaster.*

The tell-tale burrows in the banks of the nearby sandy nullah gave sufficient grounds to place the photography of this bird next on the list.

May and June are two nice sunny months in the Vale and thus, day in and day out, no qualms as regards brilliant morning lighting need be anticipated, but a banking up of heavy thunder clouds may however mar an afternoon session. It was a delight next morning to see this most colourful and ornamental bird in brilliant sunshine at close quarters.

Being gregarious by nature and nesting in colonies, a flock was concentrated in this area. The birds showing preference for being more on the wing than perched, provided an excellent view of their graceful, easy and undulating flight—a few rapid wing beats alternating with a sail through the air; a pleasant whistling trill is uttered at intervals.

The bird is slenderly built and larger than a bulbul. Its brilliant yellow throat, graded blue-green under plumage, chestnut crown and mantle show off to advantage as it manoeuvres with elegant, wide wheeling sweeps. There are several nesting colonies dotted about the Vale in suitable localities, where the soil is firm but sandy. Some choose banks of nullahs, others colonise hillocks and yet others prefer to excavate their tunnels, even on level ground.

During two successive summers a pair chose a bunker on the busy Srinagar Golf Course, and undeterred by the bellowing sounds of annoyance from golfers, successfully brought up their families. Apart from such disturbance it was thought advisable to divert caddy activity by having all caddies told to warn users of this well placed bunker that a big snake had been seen entering the hole.

The nesting tunnels, about three inches in diameter, are driven deep into the earth. For interest I had one dug out after the young had flown, and found a network of other tunnels, criss-crossing the line before the nesting chamber was reached.

The whole area appeared to form an underworld, judging by the miscellaneous collection of frogs, lizards, and beetles. I have seen the spherical white eggs and am told six from the usual full clutch in Kashmir.

My subjects for the day were building and so busy tunnelling that they afforded little chance of getting good pictures with the camera focused on the nesting hole. They scarcely paused at the entrance on arrival; though some would settle on a bare twig sticking out of a low bust on the bank before making for the tunnel. The camera site was chosen, but the setting up of the apparatus about 12 ft. away made the birds choose other convenient twigs further off. I found, times out of number, that patience and a little thought will overcome most bird problems. Allowing time enough for the birds to get used to the camera, a clod of earth was placed to block up each of four separate new burrows. The idea worked like magic. The birds presumably dismayed by this manoeuvre had their attention diverted from the camera. Seven of them sat together on my chosen twig. Had the electric release worked I might have got a picture of them all; however there were many snapshots taken of single birds, and on three occasions a pair on the same twig. Needless to say the clods were removed on the completion of the photography and the birds were busy at their work before I quitted the scene. It may be mentioned that a dapper little male Indian Bush Chat, in his neat black and white suiting, and a rich chestnut vest, also used this perch during the day and allowed himself to be successfully photographed on three occasions. A careful search revealed its nest, which contained four eggs, including a cuckoo egg, which was duly destroyed.

The tale from here onwards continues to produce many attractions, to upset my original plan, but as the Sandpiper's eggs were fresh, a few days' postponement appeared permissible. Though the small area just worked had been prolific in subjects for the camera, yet it proved to be only a taste of what was to come in this bird paradise. It was not a mile beyond this spot that the road passed over a narrow tortuous nullah, about 25 ft. wide at ground level but shelving steeply to a tiny stream, another 25 ft. lower down. The sharp twittering cries from a disturbed Pied Kingfisher, and the exit of a Kashmir Roller from the depths of the nullah, called for further investigation.

The precipitous side of the nullah was found to be honeycombed with Pied Kingfisher burrows, old and new. Those in use were zealously guarded by the seven pairs in residence to prevent rude gate-crashings by pompous and pugnacious Mynas. Ubiquitous House Sparrows, always so ready to usurp anything if permitted to do so, and finally by timid Starlings.

Two pairs of Kashmir Rollers with burrows in the same banks, also swooped down from their vantage points on a tree or telegraph wire, to keep order in this circumscribed aviary. The few willow trees thriving in the cutting gave asylum for the nests of a pair of White-cheeked bulbul, and the Rufous-backed Shrikes.

There were even two pairs of the Central Asian Kingfishers that had driven their tunnels into the bank, not more than a foot or two above the stream. Finally from this very road bridge, a pair of Hoopoes could be seen busy feeding their young, sheltered under the roots of a lofty Chenar.

To give some idea of the congestion in this area, from the 'hide' I had set up half way down the bank, I was able to take close-up pictures of seven different species by simply having to swing round the camera on its stand. Three days sufficed to complete these series, the first being employed in accustoming the birds to get used to the 'hide'.

I now propose to describe the birds using the nullah, omitting descriptions of garden and house birds, as these will be described in a subsequent chapter.

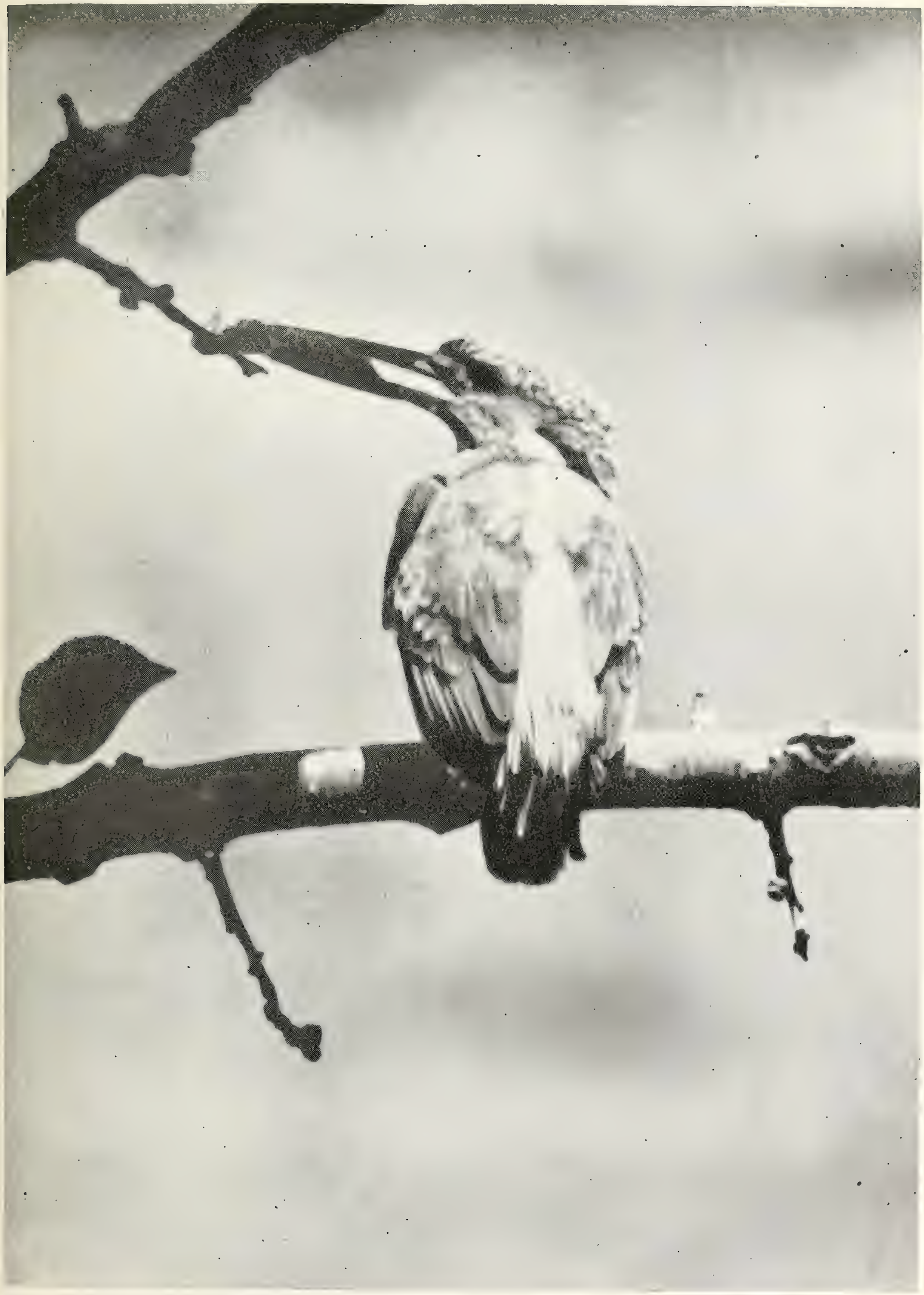
The Pied Kingfisher. *Ceryle rudis leucomelanura.*

This pied bird is a little larger than a myna with sexes alike in the main, the only striking difference to be noticed in the field shows when the birds are viewed frontally. The male has the two black gorgets across the breast, the broader one above; the female sports only one which is incomplete being interrupted by quite an inch of white breast feathering.

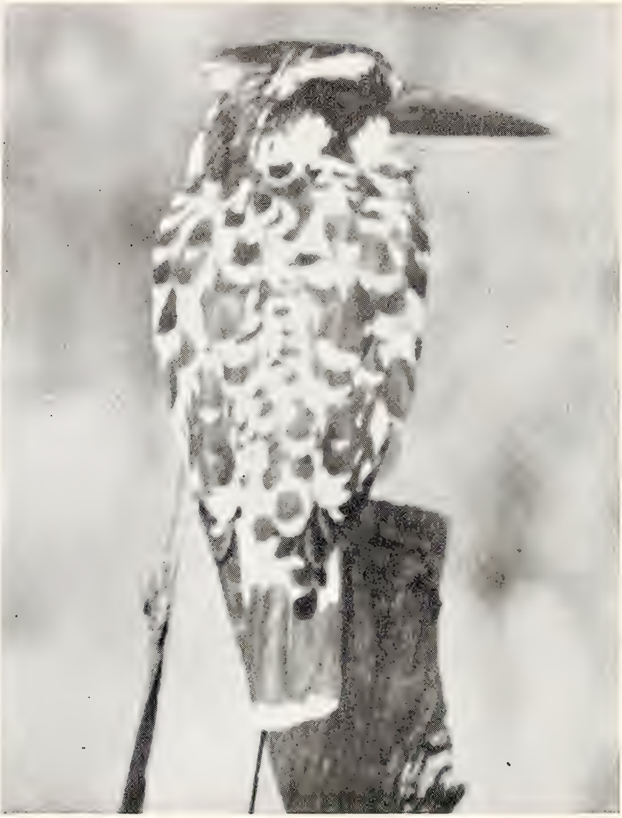
These birds are numerous and resident in the Vale, and I am of opinion that their numbers remain constant throughout the year. There are many nesting colonies in the vicinity of the Lakes each used by not more than about a dozen couples. Most of these localities appear to have been used by these birds over a period of years. The bank faces are riddled by their tunnellings, and it is evident that the burrows are used as shelters during the winter months, as, nearing sunset many birds congregate in the area and have been seen entering the holes. One unusual colony is situated at a distance of over two miles from the nearest water. The eggs, glossy white and spherical in shape, are said to number six to a full clutch.

They are noisy birds when courting, and being 'hale fellow well met', are delighted when a passing friend drops into the community. Pandemonium then reigns, while with short black crests raised, wings quivering, tails jerking up and down, everyone greets the newcomer with excited chirrupings.

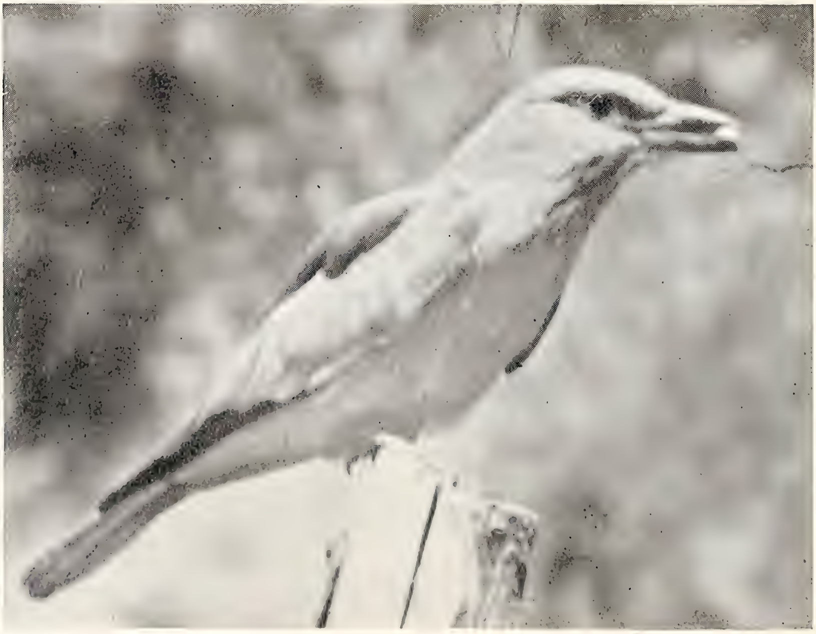
When passing along one of the many waterways, the wayfarer's attention must be attracted either by their pleasant cries, or by their hoverings high over the surface, awaiting the propitious moment to drop like a bolt into the water and seize a silvery fish. Should there be a chance of failure, the bird will pull itself out of a nose dive in mid-air and continue its flight on an even keel



The Common Central Asian Kingfisher.



The Indian Pied Kingfisher.



The Kashmir Roller.

until another shoal is sighted. It will then rise steeply and on hovering wings remain stationary, body upright, bill pointing to the water, until a lightning dive succeeds and is followed up by a picture of the bird flying off, a sprat in its bill, 'chirruk chirruking.'

On reaching a suitable perch the fish is battered about and finally swallowed head first, with a deft jerk into the air. The whole manoeuvre is most spectacular and quite unique.

Though shy of human beings, my distant release apparatus did not affect the birds in the least; in fact, on their first return to the nullah after the camera 'set-up' disturbance was over, one of the birds actually sat on the camouflaged basket covering the camera, while the other took to the perch that I had driven into the ground by the nesting hole.

After each exposure the necessary approach to the camera in order to re-set the shutter and turn on the film, disturbed the birds, but not more than ten minutes sufficed for their return with the possibility of a pair taking a seat on the focused perch.

The Kashmir Roller. *Coracias garrula semenowi.*

With the coming of Spring, the arrival of this gorgeous bird brightens up the landscape.

The Roller is solidly built and has a heavy bill. When seated it appears as an ordinary light blue bird, about the size of a pigeon. It is not until it swoops from its perch that brilliant broad bands of Oxford and Cambridge blue on its wings show up in a delightful transformation. The bird is fairly common in the Vale, and I have seen a stray pair or two on the edge of the pine forests up to 8,000 ft.

From some elevated perch it watches for shrew, frog or anything that moves on the ground. Its swoop down to capture the morsel, the return flight to the post to devour it, are all colourful manoeuvres. The abandon of the nuptial display so frequent at this time of year, during which the bird rolls and tumbles about the air uttering its harsh and raucous cries, attracts constant attention.

Even at a later period of the season when the love display has passed and one of the pair is brooding eggs, the other remains alert and always on guard. Intolerant of trespass near the nesting hole it will swoop down with harsh grating screams at the intruder. These colourful performances can be seen throughout the bird's stay in Kashmir.

As I will never dig out a nest, it is difficult to say how deep their burrows extend into the earth, but judging by the many nesting cavities laid open to view in these banks every Spring, by erosion, I fancy the birds do not tunnel for more than roughly 6 to 9 inches before evacuating the roomy nesting chambers. The eggs are glossy white and spherical and number four to six to a clutch.

These birds do not readily take to a perch near the nesting hole. It is not a question of fear but a preference to fly direct to the nest implying an inadequate exposure to the lens. As most of the nests tackled by me have been at an average height of 20 ft. above the nullah bed, a frontal 'set-up' for a 'close-up' picture is difficult.

However, very often a suitable perch, used by the birds before their final plunge into the nesting hole, can be found in the area, and by the exercise of a little patience, the camera will catch a number of good poses.

The Central Asian Kingfisher. *Alcedo atthis pallasii.*

This little bird, a gem among birds, is the northern version of the Common Kingfisher. With its solid build, long bill and brilliant green blue and chestnut plumage it needs little description as it is the most familiar bird on the Lakes and waterways of Kashmir during the summer months. It literally foists itself on one from its pénchant for perching in the open, a little above the surface of the water. The wires and posts used for anchoring houseboats are freely used. Here it will sit fearless of man and every now and again plunge obliquely into the water and return to the perch with a silvery fish in its bill. If unsuccessful in its attempt, it will fly swift and low over the water with a distinct, sharp roll of its little body, and utter a trilling note as it streaks away in search of a further suitable vantage-point.

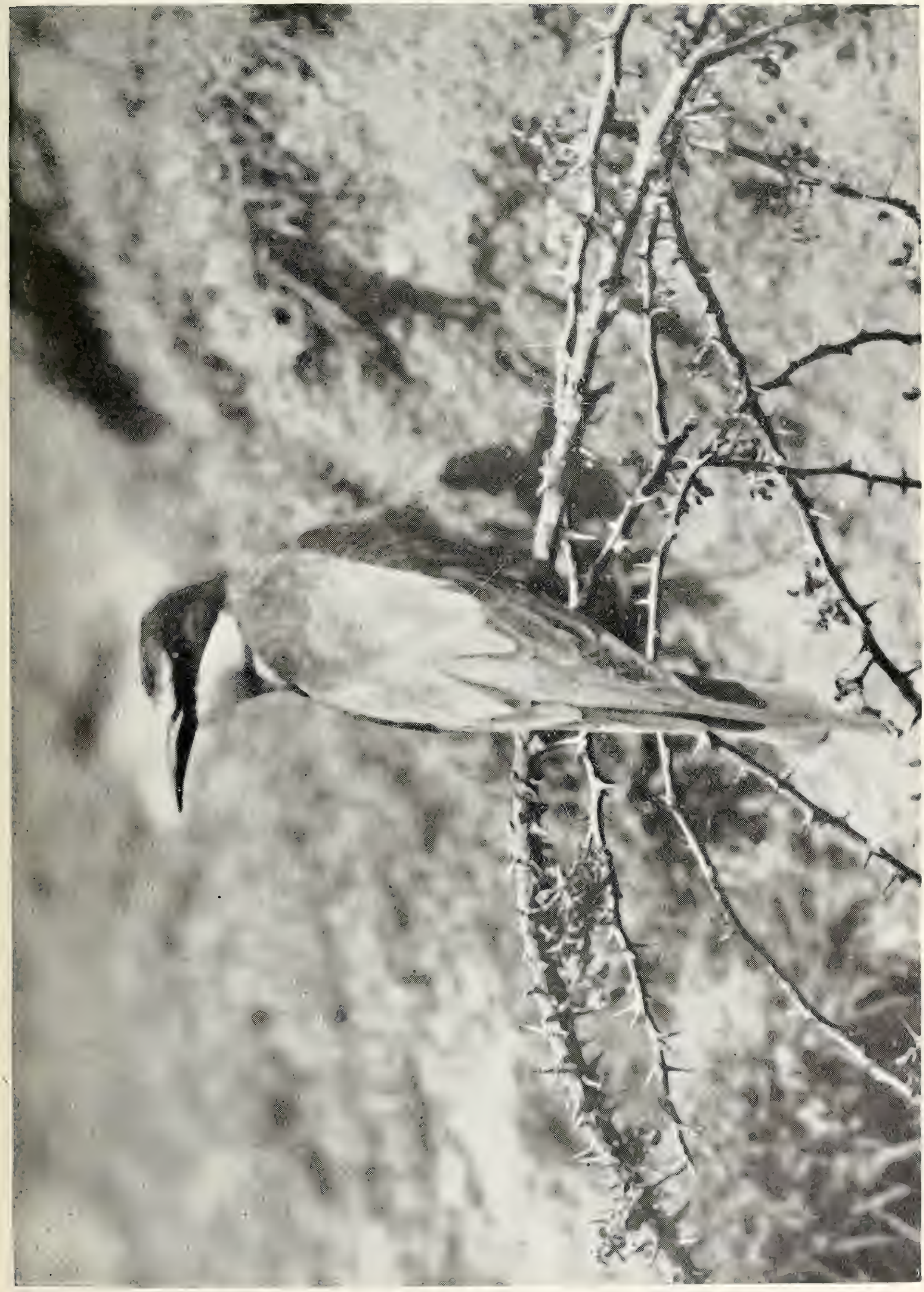
The normally accommodating gullet, stretched to its utmost by the outsize in fish presented, calls for a supreme effort on the part of the bird. A great struggle takes place, for with eyes closed, a frequent up and down movement of the head and its fanned tail flicking, the bird struggles to swallow its capture; but is little disturbed by the experience, for almost immediately the next minnow within reach pays for its carelessness.

Over open water it may be frequently seen hovering with body erect, bill pointing downwards, preparatory to plunging in after its prey.

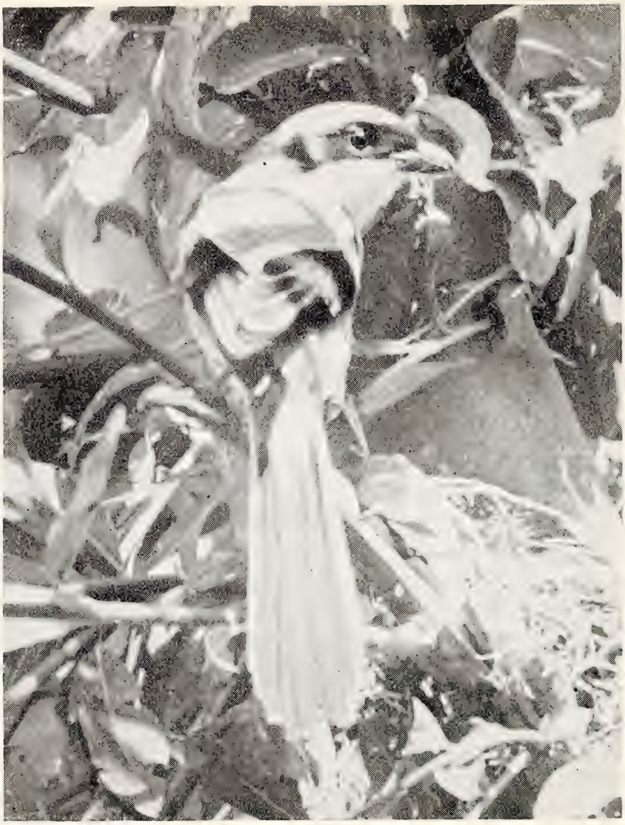
The breeding season is very extended, the main months are April to June, but young fledglings have been seen as late as September.

The nesting tunnel excavated by the birds runs level for about three feet before the actual egg chamber is reached, where the six white eggs almost spherical in shape lie. A Kashmir village is a rose garden when compared with the stench and squalor connected with the abode and upbringing of such beautiful jewels of nature. A great number of these nests must be swamped out annually, either by heavy rain storms, or snows melting which cause a rise about a foot or so above the normal level gauged as sufficient by the birds when digging out their nests.

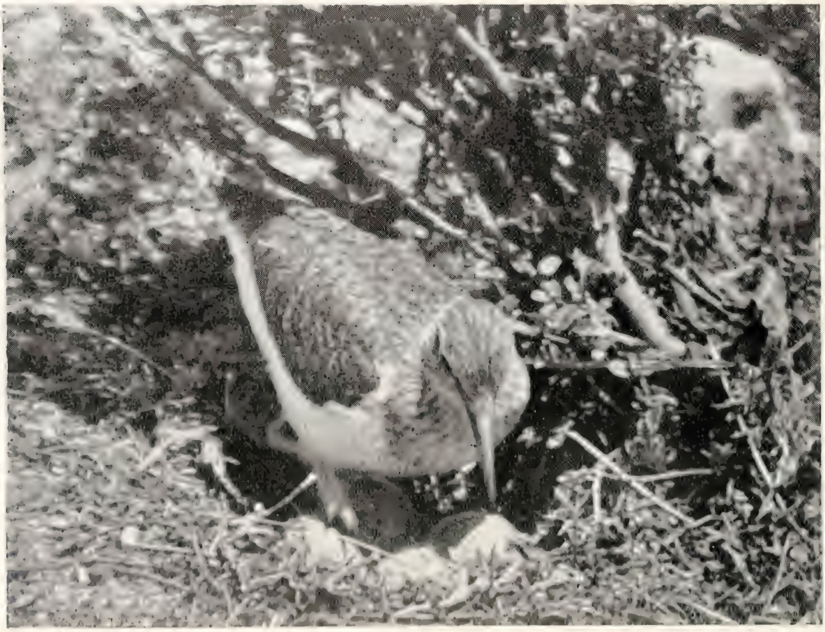
Having no fear of man and with a succession of favoured fishing posts for perches photography is easy. The first snapshot may portray a look of enquiry towards the camera, quickly followed by another showing the bird with bill lowered following in rapt attention movement in the water below and ready for a plunge into it, and then yet a third to complete the sequence, showing the return to the perch with a small fish held firmly in its bill. This sequence was actually taken by me from one of the living rooooms in my houseboat.



The European Bee-Eater.



The Rufous-backed Shrike.



The Common Sandpiper.

The Rufous-backed Shrike. *Lanius schach erythronotus.*

This Shrike is 10 inches in length, its grey head, the broad broad black band running backwards across the forehead through the eyes, the long graduated tail and severely notched bill are features common to several members of this well marked family. In this species the rich rufous lower back and rump, and the rufous-tinged abdomen are distinctive.

This Shrike is one of the most common visitors to Kashmir in summer, arriving in early April and remaining till late in September. Its abundance may be gauged by the numbers inhabiting the popular avenues bordering most highways in the Vale and by the surplus living in the willow groves and frequenting gardens. The habit of sitting bolt upright on some bare twig with long tail swaying gently up and down, the constant lookout kept to help pacify an insatiable appetite, the sudden dash down to the ground to stab at its insect prey, the laboured flight return to the original perch, make these birds conspicuous.

I have never actually found the larder of this particular species, but they are bold robbers and to them eggs are a great delicacy. A friend of mine had the aggravating experience of seeing a Shrike pounce at, and destroy the eggs in the nest of a Paradise Flycatcher while he who busy setting up a 'hide' in preparation to photograph the owner.

The flight, though laboured at the start, is swift and straight propelled by extra rapid beats from wings that appear inadequate to carry the slender body and long tail. The call notes are a harsh and loud chattering but during the early spring and the incubation periods, the cock bird has a soft and musical song, well sustained, and with a variety of notes, but so subdued as to amount to mere mumblings. An irregular flirting of the wings always accompanies these efforts at song.

The nest is a massive, deep, untidy cup of assorted materials usually comfortably lined. The eggs, commonly five to a clutch, are a white or creamy ground colour sparsely spotted and blotched with shades of brown except for the distinct wreath formed round the broad end.

One nest found contained eight eggs, and from observations, these were brooded by the one pair of birds. There is every indication that at least two broods are raised during the breeding season. The bird is victimised by the Cuckoo. The nest, usually tucked away snugly at the junction of two stout branches, the bird's rapid succession of hops to it, immediately after alighting on the tree, and its quick disappearance into the deep nest cavity are the chief obstacles to successful snapshots.

The Spotted Forktail. *Enicurus maculatus.*

It was while motoring between Chenari and Hri on the Jhelum Valley Road, along the wide stretch of it which is carved out of the mass of frowning, damp, moss-covered rock deeply fissued at intervals by miniature waterfalls, that I met my first Forktails.

The loud uncanny screams from the surprised bird as it plunged across the road just ahead of the bonnet of the car were quite startling in effect in such a wild spot. Wooded ravines holding fast mountain streams form their normal habitat.

At first sight this pied bird may be mistaken for a wagtail being roughly of that size, but on closer view, the deeply-forked long tail, gently swaying up and down, and the entire lack of hurried jerkiness in its gait emphasises the difference.

Its plumage blends well with its surroundings. The dappled pattern of white spots and lines become very obliterative in its mountain torrent home, where the shaded rocks and glittering spray tend to form a similar pattern. The large white patch on the forehead, and broad, white Y on the lower back are distinctive.

The nest is a compact and heavy cup composed mainly of green moss and clay and tucked away in a variety of places but always near rushing water. The eggs are greenish with brown spots evenly distributed over its surface.

The day after my successes in the Nullah Aviary, previously described, I was motoring to the Sind Valley and when passing the 12th milestone I was surprised to see of a Forktail feeding by the roadside in this open country miles from any ravine. This being my first real close-up of the bird, I followed its movements along the muddy drain where it was pecking its insect food, and being of a confiding disposition I was able to keep it in view along the undulating ground.

Excitement ran high, when it was joined by a second Forktail which without ado began to collect a billful of moss, with which it flew away towards the car.

My 'even time' chase soon brought me to a viewpoint overlooking the whole area, but too late to pin down the spot from which the bird had emerged. Its scream from further up the roadway indicated that it was returning to its original beat via the drain. A hurried search round revealed a surging mill-race, tumbling down over a fall in ground level about 10 ft. in depth. This appeared to me to be the only likely spot for a nest. I was about to rush back to a viewpoint which would enable me to watch both the birds and the fall, when both flew on to a fallen tree trunk, bills laden with moss. From here, each in turn, without delay flew through the cascade. On their exit the camera was hurriedly set up and I was able to get six exposures by hand from a distance of 15 ft. of the birds, as they alighted in the focused area preparatory to dashing through the water.

A bulky half built nest was found placed behind the curtain of foam on a small ledge of rock out of reach of the raging waters but made quite sodden by the misty spray.

The following year another Forktail's nest was found in similar open country. It was placed about a foot above a swift flowing canal, and as this site was not more than 3 miles away from the nest described above, it seemed indicative that the same pair had made this open country their abnormal haunt.

Some days are indeed red-lettered and this was one of them. The entirely unexpected meeting with the Forkail was to form but part of the day's gift. On reaching the rendezvous at milestone 14, the shikari was spotted sitting by the roadside opposite a quarry. He had spotted a brilliant blue Kingfisher fly into the burrow. This proved to be the nesting hole of the White-breasted Kingfisher, a bird scarce at this height in Kashmir. It was to form the main item for the morrow's photography, as all likely perching places were at this time lost to sunlight.

The White-breasted Kingfisher. *Halcyon smyrnensis.*

It was considered a great piece of luck to have found a nest of this brilliant Kingfisher at this elevation in the Vale, as I had always thought that the single birds seen at odd times must be wanderers off their usual beat. Their sporadic appearance at all seasons of the year indicate that members of a new strain are preparing to become naturalized Kashmir Highlanders.

The bird is a little larger than the Myna, though its heavy pointed dull red bill exaggerates its size. The white breastplate set in a chocolate brown under plumage is pleasing but quiet in tone compared with the dazzling turquoise-blue of the upper plumage spreading from under the brown head and neck.

It is a noisy bird whose presence in any area can be detected at a distance. The harsh 'Kenk-kenk-kenk', a succession of three rapidly repeated notes, screamed whenever the bird takes to wing, carries and is unmistakable, as is also what is presumed to be the song, which takes the form of a long-drawn-out roll of smooth notes, ascending in scale and very plaintive in tone. This song is uttered by the bird, with bill pointing up to the heavens, from its perch on some bare branch in a tree.

The entrance shaft of the many nesting tunnels of this Kingfisher shows a tendency to being dug not horizontally but on an upwardly inclined plane for the first foot or so of its length. It was this distinctive tilt that, in those far off egg-collecting days, gave me sufficient grounds to cut out any qualms about snakes and to thrust my hand without hesitation into the hole to get at the egg chamber. The golden rule followed in those days was that a hole running horizontally or downwards was not to be handled owing to the danger of its harbouring snakes, but visual evidence (fortunately) has since proved the folly of rash youthful wisdom. The fairly spacious egg chamber has never been found to contain evil smelling debris as is the case with its miniature relative. This apparent cleanliness may be the outcome of the difference in diet, as, during this session, the picturing of a pair of birds busy feeding well-grown fledgings, revealed that not on a single occasion did a parent bird bring fish to the feast but always frogs or the battered remains of lizards. The eggs are typical of the family being glossy white and almost spherical.

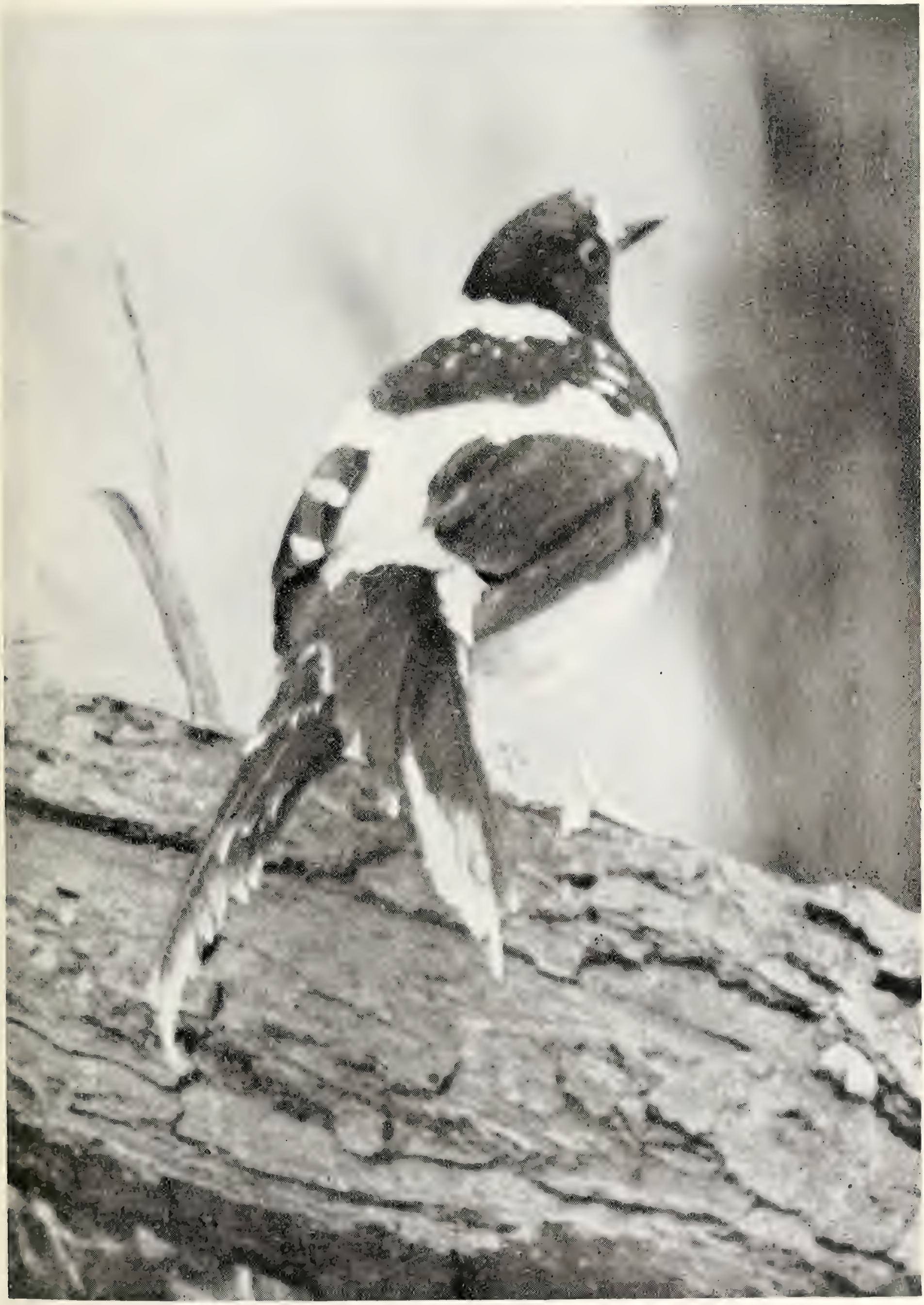
Two vivid memories of this bird in the Plains will always remain. On the first occasion, I was fortunate at finding myself witness at the start of nest-digging operations. The birds were seen following each other in quick succession, jabbing at a spot in the sandy bank. Then a circular indentation about three inches in diameter became visible affording the birds a bare purchase to enable them to continue digging. In clinging to that minute ledge, the little crimson legs had to be aided by pressure on the bank from outstretched wings. This was a picture that cannot be erased from my mind. The brilliant turquoise-blue against the sandy background was enhanced by the bright rays of a sun, low on the horizon. It gave a dazzling effect to an already delightful picture.

The second indelible instance savoured more of a timely warning. I had taken an egg collecting friend to a nest with the intention of giving him the clutch of eggs. On arrival at the site, a very agitated Kingfisher was seen thrusting at the nesting hole with much '*Kenk-kenk-kenking*'. Shortly afterwards to our very great surprise, a snake made a quick exit from the hole, fiercely attacked by the brave bird. The snake was not less than five feet in length and may have been a 'Dharman'—a harmless rat snake, but both of us could not be sure that it was not a deadly Cobra. My present pursuit—photography and the entire lack of temptation to harm a feather—undoubtedly brings sundry awards in its train.

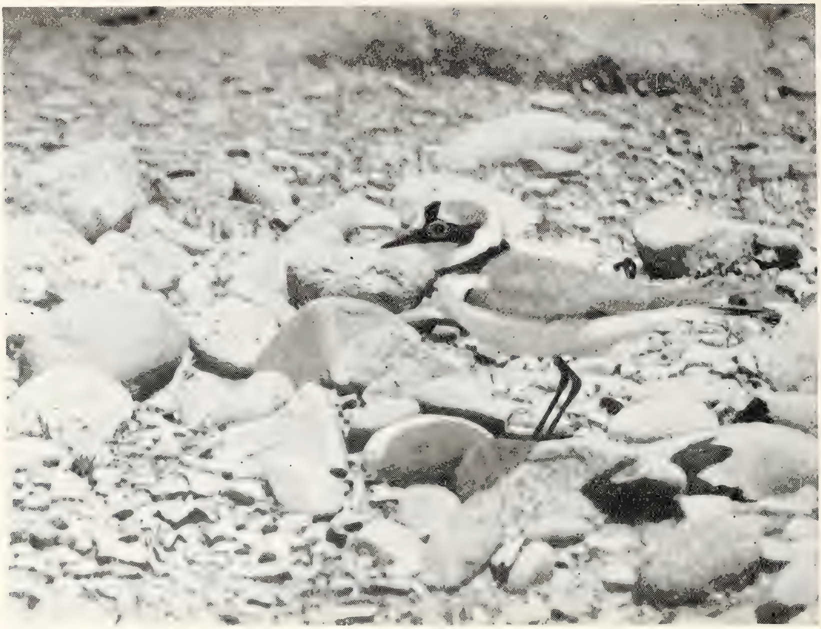
At long last, after an exciting week of photography by the wayside, the beautiful Sind Valley was reached at a point where it broadens out into the Vale. Its confined waters still swirling over the boulder-strewn bed at Woyil Bridge soon continue in a more placid strain to their junction with the River Jhelum in the neighbourhood of Shadipur. In the immediate vicinity of the Bridge are seen the many sandy, boulder-strewn islands made by the subsidiary overflows from the main stream which cut through the low lying ground bordering its northern banks. Much could be written about the wild grandeur of the upper reaches where steep cliffs and menacing gorges are lapped by its angry waters; but it must suffice here to give but an introduction to these boulder-strewn islands. They are the summer home of the Common Sandpiper, Jedron's Little Ring Plover and Hodgson's Pied Wagtail, the only water birds among others to be described here, as June provides the peak for their breeding activities. Two others, the Brown Dipper and the Ibisbill, have been described elsewhere as they are early breeders. The Dipper launches its speckled young when the Ibisbill is about to brood a fresh clutch of eggs during the first week in April.

All the birds mentioned in this chapter can be seen and watched, year in and year out, from the main road, or at most within a half mile of it. There are three notable omissions, Pallas's Fishing Eagle, with its gigantic platform nest perched on the top of a Chenar, with its trunk severed at a height of about ninety feet, and the Grey and Night Herons who still colonise the same heronry in the lofty heights of a grove of Chenars which have been used for generations by them.

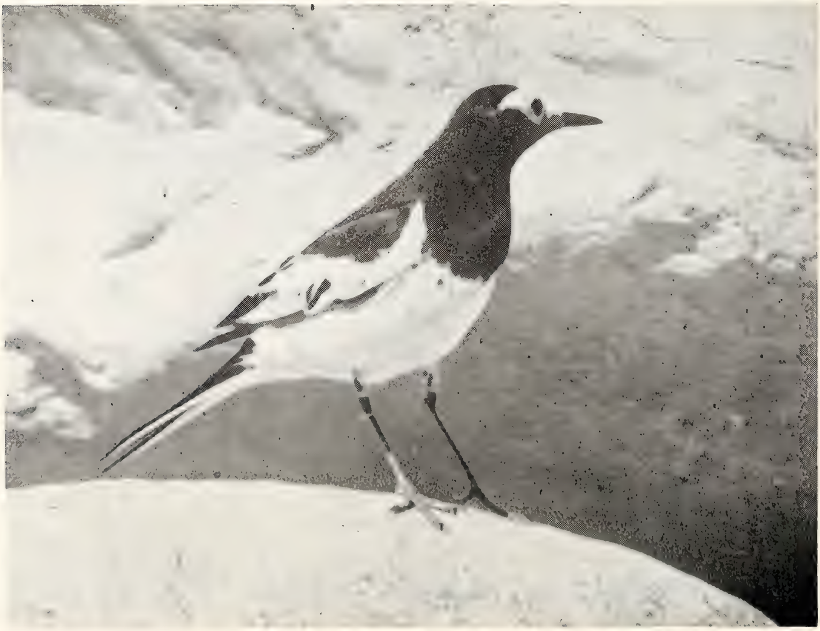
Time and again have I fought against the wise promptings that danger to life and limb weighed far too much in the scales against an attempt to photograph these birds at such dizzy heights, and so far these councils have prevailed, and no pictures have materialised. These promptings have nevertheless produced envious thoughts at the remarkable efforts of that intrepid bird photographer, E.H.N.L., who with his combination of brain and brawn knows no ceiling and thus successfully portrays subjects at incredible heights above ground level.



The Western Spotted Forktail.



Jerdon's Little Ringed Plover.



Hodgson's Pied Wagtail.

The Common Sandpiper. *Actitis hypoleucos.*

Being a summer visitor and breeding in Kashmir, this quietly dressed attractive bird, not larger than a Bulbul, is constantly seen and heard on most of the mountain streams. The plumage is olive brown above and on the breast, and white underneath.

It is a very active bird seen tripping along the margins of streams pecking up its minute food, or in quick flight low over the water uttering its shrill pipings. The flight is curious, as the upper part of the wings are held in line with the body apparently motionless, the powerful propelling force coming from the rapid downward beats from below the elbow.

The call mainly heard during the bird's visits to Kashmir has been so ably sounded by Whistler 'Kitty-needie, Kitty-needie, Kitty-needie'—this appears to be an emotional love song, and is more in evidence than the normal shrill piping notes used when on the wing.

Many 'eternal triangle' scenes are witnessed at this season, and how universal is the guile practised by the fair sex. One, betrothed, will show keen interest in a newly alighted beau, who with wings raised vertically above the head will proclaim his presence with a pretty Kitty-needie, Kitty-needie, Kitty-needie, and look his best doing so. This play, however, is of short duration for the new intrigue is snapped in the bud, by the hasty arrival of the rightful owner who hustles away his erring spouse.

The nest is usually placed on the ground under a low tamerisk bush, or some other vegetation growing on these islands. Some are sketchy affairs with little grass, others more solidly built. The eggs are four in number, pear-shaped, and lie in the usual 'Wader' fashion, sharp ends pointing to the centre of the nest. They have a buff ground spotted and clouded with shades of reddish-brown. It is of interest to note that a nest of this species was found with full clutch up in Gulmarg 9,000 ft., which was successfully hatched out in July.

The bird is a very difficult subject to photograph, except when seated on the nest, owing to its rapid movements, even when standing, its continual sharp nodding of the head and flirting of the tail. Further, even if a high viewpoint overcomes the faulty guesses concerning its entry into the focused area, its aggravating habit of tripping along, at breakneck speed, while crossing the last yard or two to the nest, is too much for even a 1/500 second exposure.

Jerdon's Little Ringed Plover. *Charadrius dubius.*

This tiny plover, no bigger than a sparrow, is a summer migrant and delightful to watch. The plumage is sandy-brown above and white beneath, with black bands across the forehead and round the neck. An additional broad black gorget spans the breast.

The plaintive whistle will probably first attract attention. Then the bird's swift wheeling flight—a rapid beat of sharply pointed wings. On the ground it dashes along the sand with legs twinkling so fast as to become invisible, its rapid spurts are punctuated by short pauses to seize its prey with a curious hinged to knee-joint tilt of the body. Further spurts and pauses follow. In spite of its untiring activity, the bird is difficult to keep in sight, as its whole make-up tends to obliterate the contours of its body.

There are two distinct types of nesting sites in the Vale, the small scrape is made either on sandy pebbled ground, or in clay in the middle of bog. The curious haphazard laying of two or three blades of grass across the scrape appears to be common to most nests. The nests being placed in the open, suffer much from the hoofs of wandering cattle.

The four eggs, in common with those of most waders, are very large in size and pear-shaped. The buff or grenish ground spotted with brown produces a very protective design.

Thanks to the habit of constantly pausing between runs, the bird is a very easy subject to photograph in most of its characteristic attitudes.

Hodgson's Pied Wagtail. *Motacilla lugubris alboides.*

This is a very common and friendly bird found in numbers in summer on the Kashmir streams where it breeds profusely. It is of slight build and elegant, the male looking dainty in his black and white, and only differing from the female in the colouring on the back, which is grey in the latter.

These slender birds are pleasing to watch, for they are seldom seen at rest but always with the tail wagging non-stop, much to the detriment of photography. It chases its insect prey at great speed along the ground and seldom grants reprieve to an insect endeavouring to get away on wing—for the bird sallies after it in the air and having completed its mission returns to land, emphasising the success by much more tail-wagging.

The flight is also very noticeable for it is accompanied by a cheerful 'chezzit' uttered usually during the downward swoops in its series of regular undulations in the air. During the breeding season the male bird has a powerful call and is also often heard soliloquising in a medley of soft notes, pleasing in rhythm.

The normal nesting site is among rocks, but in Srinagar a pair once commenced to build on my houseboat and continued to do so throughout its twenty-mile move upstream. The birds appeared to be quite undisturbed, flying off to the shore and returning to the moving boat with further material for the nest. The comparative few that inhabit Gulmarg, almost without exception, desert the banks of the streams and prefer to complete nidification under a friendly and accommodating roof. The nest is of grass or other similar material with the cup-shaped interior neatly lined with hair or wool. Five appears to be the normal number of eggs found. They are of a light grey shade profusely covered by tiny spots of brown.

A great deal of keen interest is aroused for the bird watcher in the Vale of Kashmir in his efforts to prove or disprove opinion of authorities regarding the breeding of two closely allied species of White Wagtail.

Although the general consensus of opinion is, that Hodgson's is the only species breeding within Indian Empire limits, yet one authority claims that the Masked Wagtail also breeds commonly in Kashmir. The striking similarity shown by the males of four species of this family and their presence in numbers all over India during the winter months urges one to centre interest on each bird in the legions of pied Wagtails seen here during the breeding season. Up-to-date I have never found a nest of the Masked Wagtail, in spite of hopes often raised by the appearance of a wagtail, which may prove to be the Masked Wagtail, in an area where another female wagtail was brooding her eggs. This keys up one's hopes to the possibility that the newly alighted grey-backed bird might be its male owner and thus give sufficient proof that the nest was indeed that of the Masked Wagtail. Time and again these hopes have been dashed to the ground by the casual arrival at the nest of the male Hodgson's, proving that newcomer was not the rightful owner of the nest, but possibly another stray Hodgson's female. The close resemblance between the male Masked Wagtail and Hodgson's female makes such supposition possible.

ON *PESCHETIUS* GUIGNOT (COL., *DYTISCIDAE*) WITH A DESCRIPTION OF A NEW SPECIES FROM INDIA.

BY

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Peschetins Guignot (1935).

Guignot, 1935, Rev. franç. Ent., **2**, 131.

This genus was erected to include the Indian species, *Hydroporus quadricostatus* Aubé, and the two African species, *Hydroporus carinipennis* Régimbart and *nodieri* Régimbart. Unfortunately Guignot omitted to cite a genotype and by so doing technically invalidated his creation of the genus according to Article 25 as amended at the International Zoological Congress in Budapest, 1927. The genus is certainly to be accepted as distinct and I hereby cite *Hydroporus quadricostatus* Aubé as genotype in order to give it validity.

The generic characters adduced, in the first place by Peschet (Voy. Guy Babault en Afr. or. angl., 1921, 14-15), are :—Coxal lines cariniform, limiting between them a deep depression, wide in the middle ; first ventrite with large deep foveoles to the number of two or three in *carinipennis* Rég. and *nodieri* Rég. and from six to seven in *quadricostatus* Aubé ; second and third ventrites fused, the suture separating them only barely visible laterally; second ventrite on either side of the middle line with a deep semicircular impression serving as cavity for the trochanter and base of femur of hind legs; third ventrite sub-tectiform, strongly elevated at the apex; three terminal ventrites seen laterally not on the same plane as the three anterior.' To these are added by Guignot:—'First antennal segment much longer than the second, the epipleurs reaching the apex of the elytra.'

The force of the characters listed above is by no means uniform and the two characters suggested by Guignot, the second being strongly stressed by him, do not appear to me to advance the principal character mentioned by Peschet—the unusual coxal lines—since certain species of *Deronectes* s. str.—*bicostatus* Schaum—have the basal segment of the antennae distinctly longer than the second and the epipleurs cannot be said to attain the apex (sommet) of the elytra to a greater extent than some *Deronectes*.

Two further characters not mentioned by either author appear to me to be of primary importance, viz.:—the ridge on the inner face of the elytra terminates in a distinct waved or double ligula and at the base also develops a distinct lobe; the hind coxae are much more developed than in *Deronectes*, the metasternal wing being distinctly arched and of an almost uniform thickness nearly up to the apex. Neither of these characters is to be found in any group of *Deronectes* and to them may be added the total absence of a true pronotal margin, a state almost reached by some species of the compared genus although in all of them a distinct trace remains near the anterior angles. A further feature is seen in the unusual course of the true elytral margin near the shoulder where it dips down very sharply so that the epipleur appears to be very nearly parallel-sided to the level of the first ventrite, a structure entirely peculiar to the genus among the *Hydroporinae*. It also deserves comment that the epipleurs are throughout coarsely punctured; the hind femora impunctuate; the hind tibiae have two longitudinal rows of piliferous punctures on the infero-external face, the rest of the surface being reticulate, impunctuate; and that the spurs of the hind tibiae are unequal.

Guignot suggests that the genus should be placed near *Antiporus* and *Macroporus*, chiefly on the character of the epipleurs. Although, as I have shewn, the force of the character of the epipleurs is not very great it does appear that the genus is best placed between *Antiporus* and *Necterosoma*, with each of which it has many affinities. The following new species is to be added to the three already included:—

Peschetius andrewesi sp. n.

(*Deronectes andrewesi* Régimbart in coll.)
(*Deronectes belli* Régimbart in coll.)

Elongate-oval, subdepressed, rufo-ferrugineous; *head* broadly black from the posterior margin of the eyes almost to the anterior margin of the fronto-clypeus, the vertex rufo-ferrugineous; frons moderately densely and shallowly, coarsely punctured, the interstices of the punctation about equal to the diameter of the punctures, more or less obsoletely microreticulate, the punctures gradually decreasing in size and somewhat sparser towards the anterior margin; on either side with a large shallow fronto-clypeal depression; vertex strongly, almost shagrinate microreticulate, the meshes absolutely regular, impunctate. *Antennae* long, the basal segment at least as long as the two following taken together, the fifth, sixth and seventh segments also rather elongate, sub-equal, rufo-flavous. *Pronotum* transverse, the sides widely rounded, quite unmargined, with a shallow longitudinal impression on each side, well separated from the edge and a sub-basal transverse impression connecting on either side with the longitudinal impressions, posterior angles slightly obtuse; closely, regularly and uniformly punctured, the punctures separated by about their diameters, the interstices dull microreticulate; rufo-ferrugineous, a small black basal mark on either side of the middle line; scutellar lobe very slightly developed, the hind margin being only slightly rounded in the scutellar region; prosternal process large, strongly laterally compressed, strongly rounded, not carinate tectiform (c.f. *quadricostatus* Aubé), the apex bluntly rounded, lateral margins obsolete; intercoxal piece of the prosternum without a transverse step or rugae. *Elytra* elongate-oval, sides very slightly rounded and widened to the middle, widely rounded posteriorly, weakly acuminate at the apex; as wide basally as the base of the pronotum but the angle of junction of margin with the edge of the pronotum very pronounced owing to the abrupt upward curve of the epipleural margin; two longitudinal costae, the inner straight and commencing directly behind the base of the elytra and attaining to four-fifths of their length, the outer one beginning some distance behind the shoulder and running almost parallel to the inner one for three-quarters of its length and then widely rounded convergent to join the inner costa at its apex; margin abruptly curved upwards at the shoulder; epipleura and dorsum punctured and sculptured as on the pronotum; rufo-ferrugineous with the black pattern common to all the species of the genus. *Venter* rufo-ferrugineous, the edge of the hind coxae and abdominal ventrites infuscate; metasternum and hind coxæ sculptured as on the dorsum, the impression between the coxal lines almost impunctate, shining; basal abdominal ventrite with seven to eight shallow oval, sharply impressed foveae on either side of the middle line, their cavities microreticulate; second and third ventrites fused, the second with five similar foveae and numerous large punctures on either side of the middle line, the middle line rather pinched, almost carinate at the base; sixth ventrite dull, microreticulate, the edge strongly, the disc very finely punctate (c.f. *quadricostatus* Aubé). *Legs* moderately long, the tarsi of the male slightly more dilated than in the female on the anterior and intermediate legs, fourth segment small but distinct, fifth quite elongate, as long as the second and third segments taken together; claws simple in both sexes.

Type.—India: Nilgiri Hills (*H. L. Andrews* coll.). (*Deronectes andrewesi.* Reg. n. sp. typ., Regimbart det.). Paratypes.—3 specimens, same particulars as type. 2 specimens, S. India: B.M. 61-20—Coimbatore, Koondah Hills or Nilgiri Hills (*M. J. Walhouse* coll.). 2 specimens, India (without further particulars), (B.M. 67-56, ex coll. Hamlet Clark.). 6 specimens, India: Khandesh (*T. R. Bell* coll., ex coll. H. L. Andrews), (*Deronectes belli* Reg. n. sp. typ., Regimbart det.). 1 specimen, India: Igatpuri, 2,000 ft. (ex coll. H. L. Andrewes).

Size.—2.9-3.35 mm. long, 1.5-1.6 mm. lat.

(All specimens are in the British Museum.)

This new species is very similar to the three already described. It may easily be distinguished from *quadricostatus* (Aubé) by the black fronto-clypeus and the dull, microreticulate, much more finely punctured sixth ventrite. From the two African species it may be separated by the greater number of foveae on the first ventrite, and from *[illegible]eri* (Rég.) it is further separated by the black fronto-clypeus whilst *ca[illegible]pennis* (Rég.) lacks the post-humeral extension of the sub-nasal black band to the margin, possessing instead a longitudinal band along the outer edge of the inner carina which joins the discal black band.

The lateral lobes (parameres) of the aedeagus are of a form unusual in the *Hydroporinae*, in which they are frequently hooked at the apex. In *Peschetius* they are terminated by a weakly inflated elongate rounded lobe provided with numerous long hairs along the inner face, a type normally found in the *Colymbetinae*. The significance of this character in a group otherwise indubitably Hydroporine is not yet apparent.

I am unable to find any distinctions between *andrewesi* and *belli* (Rég. i. 1) and dissection has shewn the aedeagus to be identical and accordingly I have adopted the former name for the species.

MICRODYTES GEN. NOV. DYTISCIDARUM (*HYPHYDRINI*).

BY

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Microdytes gen. nov.

Head transverse, eyes quite small; anterior edge of the fronto-clypeus without a trace of a raised or produced rim, the apex transverse, not rounded, labrum visibly exserted, emarginate in the middle. *Pronotum* transverse, sides narrowly margined; base at middle distinctly, but not largely, roundly produced; prosternum extremely small in front of the anterior coxae; prosternal process small, lanceolate-lobate, the apex rounded, not acuminate, transversely weakly convex, the sides margined at base. *Elytra* widely rounded, the inner face with lamina expanded into a prominent ligula at the apex; epipleurs at shoulder with a 'bordered pit'. *Venter*: Meso-coxae distinctly separated; mesosternal fork very minute but distinctly attaining the intercoxal process of the metasternum which is shallowly, roundly grooved. Metacoxæ very large, the anterior margin strongly arched, the posterior soldered to the anterior margin of the first abdominal ventrite; metacoxal processes adpressed; base of the trochanter completely exposed, the articular cavities distinctly separated; coxal lines terminating at the articular angle, not turned inwards and prolonged; metasternal wings very narrow and strongly arched; sutures of second and third ventrite completely obsolete. *Legs*: hind tibiae on the infero-external face with two longitudinal series of spiculiferous punctures, the upper series not set in a distinct groove obliquely; segments, particularly the basal one, simple, without a weak but distinct longitudinal dorsal ridge, reticulation obsolete; hind tarsal claws unequal but the shorter one quite distinct and about two-thirds the length of the longer one.

Genotype.—*Microdytes belli* (Rég. i. l.) n. sp.

This new genus is a member of the tribe *Hyphydrini* and is very close to *Desmopachria*, from which it is not easy to separate it, but it is undoubtedly a distinct genus on the slight but constant differences e.g. truncate and unmargined anterior edge of the fronto-clypeus with a more visibly exserted labrum, slightly different course of the coxal lines, shorter trochanters, presence of two linear series of spiculiferous punctures on the infero-external face of the hind tibiae, the upper series not set in an oblique groove, the absence of the median longitudinal ridge of the dorsal surface on, at least, the basal segment of the hind tarsi, and the longer outer (lower) claw of the hind legs.

It is possible that *Hydrovatus maculatus* Motschulsky (*Stud. Ent.*, 8, 1859, 42), re-described by Régimbart (Ann. Soc. ent. France, 1899, 231) and transferred to *Desmopachria* by Gschwendtner (Rec. Ins. Mus., 37, 1935, ?) may belong to this genus, but no description I have seen deals with the course of the coxal lines, the punctures of the hind tibiae or the characters of the hind tarsi and tarsal claws. Until an authentic specimen of that species can be examined for these characters its position must remain doubtful.

Microdytes belli (Reg. i. l.) n. sp.

Head: rufo-ferrugineous, very finely but quite copiously punctured, the interstices four to five times the diameter of the punctures, quite shining and without a trace of reticulation except along the anterior edge of the fronto-clypeus where an extremely fine and lightly incised meshwork can just be seen. *Antennae*: rather short and slender, the anterior edge very slightly serrate, the first and second segments subequal in length and width, the second as long as the third and fourth taken together, the fourth very short, as wide as … *Thorax*: pronotum fusco-castaneous, the anterior, posterior and lateral marg narrowly paler; the sides finely but distinctly margined, the posterior angl almost acute but not at all produced; the scutellar lobe very shortly roundly produced; the surface strongly shining, regularly, more strongly than on the head and rather more copiously punctured, the punctures three times the size of those on the head and the interstices two to three times the diameter of the punctures; prosternum exceptionally narrow in front of the pro-coxae, the prosternal process small, lanceolate-lobate, terminally rounded, weakly convex, the sides distinctly margined at the base; anterior tarsi four segmented, laterally compressed, the claws simple and equal. Metasternum and metacoxae with the sutures almost obsolete, highly polished, rather coarsely, regularly and evenly punctured on the coxae, the sternum antero-laterally coarsely, posteriorly finely punctured, fusco-castaneous, the coxal processes rufescent; hind femora not at all inflated; hind tibiae not much narrower at base than at apex; calcaria stout, unequal, simple, the longer as long as the basal segment of the hind tarsi; the hind trochanters shorter than the posterior edge of their femora from the apex of the trochanter to the 'knee'. *Elytra*: regularly ovate, the sides dilated just behind the shoulder, the apex strongly rounded, not at all acuminate; giving the insect an almost rhomboidal outline; fusco- or nigro-castaneous with a broad transverse basal fascia dilated at the shoulder and continuing moderately widely along the margin to just before the apex with a confluent spot or enlargement laterally behind the middle and a second anteapically, a small round post-median spot near the suture, flavous, the surface highly polished and shining, punctured as on the pronotum but laterally more sparingly with the 'systematic' serial punctures almost or quite obsolete. *Abdominal* ventrites very highly polished and shining, the basal segment laterally with a few obsolete large punctures and some also on the second segment, the rest of the surface, even of the sixth ventrite, quite impunctate.

Size.—1.83-1.86 mm. long., 1.29-1.32 mm. lat.

Type.—India: Bombay Pres., Khandesh (*T. R. Bell* coll.; ex coll. H. L. Andrewes).

Paratype.—1 specimen, same particulars.

(Both specimens are in the British Museum.)

Both specimens appear to be female, by comparison with *Microdytes championi* n. sp., described below, assuming the sexual characters to be the same for both species.

Microdytes championi n. sp.

Head: flavo-testaceous to rufo-flavous, finely, slightly, irregularly but fairly copiously punctured, anteriorly finely microreticulate but shining, the vertex strongly shining and without a trace of reticulation, the punctures here slightly larger. *Antennae*: as in *belli* n. sp. *Thorax*: pronotum flavo-testaceous to rufo-castaneous, the anterior edge narrowly infuscate, the posterior edge more widely obscurely infuscate in the middle, the sides finely margined, the margin black, the posterior angles almost acute but not at all produced; fairly copiously punctured, the punctures irregular, those on the disc finer, along the posterior edge coarser and a transverse band of almost equidistant larger punctures along the anterior margin, laterally the discal punctures become obsolete and the larger punctures reduced in size; prosternum as in *belli* sp. n. Metasternum and meta-coxae as in *belli* but the punctures much sparser and less regular; legs as in *belli*. *Elytra*: regularly oval, widest almost at middle, the sides evenly rounded, the apex more roundly attenuate than in *belli* but not at all acuminate behind, the form more elongate-rhomboidal than *belli*; flavo-testaceous, the anterior and sutral margins black or blackish and a fusco-rufous or dark castaneous broad, transverse, anteriorly waved band on the disc which does not attain the declivous portion of the side of the elytra, posteriorly the band is sinuous with a linear posterior extension on the disc terminating ante-apically in a rounded spot, the surface finely and fairly copiously punctured near the suture, progressively slightly more sparsely towards the sides, the 'systematic' series of punctures distinct, particularly the inner one, almost to the apex, the interstices of the punctation highly polished and shining. *Abdominal* ventrites highly polished and shining, the basal and fused second and third ventrites with a moderately copious fine punctation towards the sides, the sixth ventrite excessively finely and rather sparsely punctate, the surface highly polished and shining.

Size.—1.86-2.07 mm. long., 1.29-1.42 mm. lat.

Type.—India: United Provinces; Kumaon, Haldwani Dist., ♂ (*H. G. Champion* coll.).

Paratypes.—same particulars, 54 specimens.

(The type and 32 paratypes in the British Museum, the remainder in coll. (Champion).

This species is readily distinguished from *belli* by the colour, the greater extent of the reticulation on the head, the distinct systematic series of the elytra, the sparser metacoxal and more plentiful, finer punctures of the basal abdominal ventrites. The only apparent secondary sexual character is seen on the lobes of the labial mentum where the male has a dense tuft of long golden hairs, the female having this part glabrous. This is a very unusual secondary sexual character of the Dytiscidae and no similar case is known to me.

SOME REMINISCENCES OF SPORT IN ASSAM.

BY

H.G.H.M.

Part IV

Along the base of the Bhutan Hills is an extensive Game Sanctuary from which tigers find their way to other dense jungles which are a natural sanctuary and in which they cannot be attacked until they roam further afield into the more open grass jungles bordering on cultivated areas. Then they become cattle lifters and so expose themselves to sportsmen; but it is only with the aid of elephants that they can be successfully dealt with.

On a cold weather morning in early March, on alighting from the train on the Eastern Bengal Railway at the wayside station of Sarupeta in Assam, it was a fine sight to see some fifty elephants lined up to meet the guests of the always hospitable Rajah of G. Soon we were all sorted out and seated in our howdahs. The programme was to beat through the jungle towards camp about seven miles away, and there was hope of tiger being seen as there had recently been 'kills' in that area; but we had no success.

The next day we started out fairly early, and though there was no 'khubber' of a kill, the beating line, after a deal of hard work, put up a tigress with small cubs and of course, as usually happens in such cases, she charged the line not only once, but twice, and the Raj Kumar, who was with the beating elephants stopped her by firing shots though she could not be seen. Eventually she left the cubs and was with considerable difficulty driven to the Maharajah of M. Several of the other guns could have shot her but the order was that she should be killed by the Maharajah; and so she was, with one well aimed shot. Returning to where the cubs were last seen, after much searching, in which the elephant's aid was invaluable, we found two of the snarling little creatures, the size of foxterriers. Secured by the mahouts who threw blankets over them they were deposited, in cane cages which were always taken out on these big shoots on one of the pad elephants.

Although so recently caught, it was not long after they had been in camp that they permitted friendly patting of the head. In many parts of India it is not considered proper to shoot tigresses with small cubs, but in those enormous jungles teeming with wild animals of every description that was not the custom. All this caused much delay, so there was no more shikar, the Rajah having rightly insisted that as the mother had been killed her cubs should be found.

On the following day the Maharajah of M. was obliged to leave the camp and we had no success until after lunch when we found ourselves near the place where, the previous year we had killed six tigers in less than an hour. I had intended to take photographs but was told a tiger must be shot by me so I was posted where the tigers, if any in this promising cover, would be most likely to break. The Rajah made his usual very careful arrangements, posting each howdah elephant himself, and walking his elephant up and down behind the line, which was placed at right angles to the beating line, so that it would be safe to fire straight ahead. My position was away to the right front of the line at a spot where the tigers, having been driven from heavy jungle through light jungle, would naturally take again to the heavy cover in front of them. Orders to the line of howdah guns were that no shot was to be fired unless the tigers attempted to break through them to gain the heavy cover behind. I realized that it was quite likely the tigers, finding me in their way of retreat, would charge my elephant and was prepared for this.

Now the beating line was set in motion, and before long it was signalled that there were three tigers in front of it. These turned out to be a tigress with two three-quarter grown cubs. The tigress moved as expected, while the other two came along nearer the line of howdah elephants and were clearly seen as they made their way through the light jungle. When nearing me the tigress suddenly discovered the presence of my elephant, grunted and charged. I waited until she was close, and as the bead marked a point between her shoulders, I pulled the trigger and missed! Doubtless it was the common error of seeing the foresight and not the backsight also, so the bullet went high. She stopped, immediately jumped back, and ran into the jungle she had come from and was seen and missed by some of the other guns. Barely had the mother gone, when the two cubs were almost into my elephant's legs. Quickly they turned back and I feared to fire towards the now approaching line of beaters. One of the cubs, followed up by a member of the party, presented an easy shot and was killed. It was getting late so a beat for the tigress and other cub had to be quickly arranged. A narrow strip of jungle was broken down by the many elephants available—there were not far short of a hundred, as the Maharaja of M. had left his beasts although he himself had been obliged to go to Calcutta. The beat was now turned right about to force the hunted animals across the narrow cleared strip to the waiting guns on the further side. These were—from right to left, M. Junior, the Second

Kumar, quite a youth, myself and the Kumar: four guns. Behind us was the thick jungle and before us the imposing line of beating elephants. Away to our right were the surplus elephants which had trodden down the clear space, with the Rajah of G. and other guests.

First arrived the cub which received one bullet from the Raj Kumar's .500 rifle loaded with Low Pressure cordite cartridge having a 440 grain soft nose bullet; such a combination is very good for close shots afforded in howdah shooting. The Raj Kumar had only just reloaded when the tigress, now in very savage mood, sprang at his elephant's head but the spring was avoided by a rapid twist and the Raj Kumar, missing her in the air, gave her a second shot as she landed on the ground. This she answered with a grunt and sprang growling savagely into the grass. The younger Kumar was now ordered out of the jungle as it was not safe for him to take part in the approaching scrimmage. He was using a .400 black powder rifle taking a 230 grain bullet and 80 grains powder. This weapon is not good enough for a fighting tigress but I have seen the boy kill more than a dozen tigers with it, one shot apiece. One of them, shot in the chest, measured ten feet, a very heavy male.

The Raj Kumar and I closed our elephants on the tigress. She charged again and was received with two hits, this time again retreating. Three beater elephants were moved up to push the tigress out and she charged one of them, getting astride the tusks of a big elephant named Urthumpersad. He went round and round like a top in the grass in attempting to throw her off, the two other elephants close by doing the same. During this it was not possible to shoot, and when at last the tigress was dislodged she charged the Raj Kumar who settled her with two shots. A fine beast she was, measuring nine feet.

It was this Urthumpersad which had been ordered by the Assam Government to be shot, but which had been bought by the Rajah of G. He was then exceedingly timid, but tigers have now been shot from his back and he will likely turn out an excellent howdah elephant, the result of expert training and management. Mrs. S, who knew all the Forest Department elephants at Kochugaon will be interested to know this, should she come across these reminiscences. We padded the three tigers and returned to camp. Even this day's sport showed that tiger shooting from elephants is not always a tame affair.

The following day only one tiger was shot and this fell to the Second Kumar and his light rifle. The bullet mushroomed perfectly. The day after that, the 11th March, five tigers were bagged. On this day it was again wished by our host that I should kill a tiger. The beat had just started and I was arguing with G's Doctor, who was in the back seat of the howdah, as to the possibility of a charge. He was saying that tigers, on hearing the advance of the beating elephants move to the edge of the cover, and if they do not detect the waiting howdah elephant move off to the next jungle in a very silent manner; also he was insisting that they often break back before the shikaris think they do, and that the tiger may be even now at the expected exit place—when out the beast jumped with a grunt! I was taken by surprise and missed, the result of want of proper attention to the matter in hand. Never must one's mind be diverted for an instant or such chances will be lost. The tiger for some unaccountable reason ran into the open and was twice fired at by other guns, but went on as if untouched. Then the Rajah fired and it dropped to the shot and rolled into the cover on the edge of which it was at the moment. The Raj Kumar, who was further ahead, saw some movement in the high grass and a couple of elephants were sent to push through the cover: shortly a tiger showed in the nala close to where the wounded one had disappeared. G. fired and it jumped into the grass and died. All movement having ceased an elephant was sent in to investigate and to the surprise of everyone, the mahout announced 'two dead tigers'. When the bullets were recovered from the bodies it was found that besides the .465 used by the Rajah there was a 12 gauge Paradox conical bullet from the weapon used by M. Junior. This had been fired at a range of about 75 yards and had had no effect, though well placed. The beast had not even acknowledged the hit. Fifty years ago the Paradox, and other imitations of the idea, had a great vogue, but experienced sportsmen placed not much reliance on them except for close shots. I have seen a tiger, hit in the chest with one of these heavy conical bullets at close range, roll over but get up and move on as if unwounded. It was killed by another gun who does not know to this day that he shot a previously wounded animal. The good sportsman who used the Paradox did not claim the beast as the other man had never shot a tiger. After this we moved on and came to a place where four tigers were found. The tigress and her three nearly full grown cubs were at one time bolting all over the place in the light cover, and nearly everyone had a shot at them, but all without success. Another beat was arranged and in this I knocked over the tigress with my .280, rather an overlong shot. She got up and charged the beating line but was killed by one of the howdah guns. One of the large cubs, they were about eight feet long, was shot by M. Senior as it charged past his elephant, and another was killed by the Rajah with a charge of No. 4 shot from his gun. He leaned over the side of his howdah and it fell dead, the skull smashed to a pulp. The cub which had escaped killed a cow that night and was shot next day. On the 14th the elephants were given a rest, and then there was news of a man-eating tiger, and several others, in a certain locality. An early start was made as the distance was considerable.

Death of a man-eater.

The hut from which the man had been taken was situated very close to heavy jungle. It was still occupied, in spite of this having been about the twelfth or fourteenth man taken from the neighbouring village. The people are fatalists and say that when a man is taken by a tiger—it is his fate, and do nothing to save themselves from a similar doom. This tiger had killed a cow that very morning and dragged it into cover near a stream. The ground on both sides of the stream, as well as the stream itself, was very boggy. Two of the elephants got badly bogged and had to be assisted out by others. Had there not been plenty of help available it is quite likely these two animals would have perished. Eventually all the elephants crossed the place, but four or five had to be left behind as they were quite exhausted. Here is another reason why this form of shikar is dangerous at times.

It is not often that elephants fall, they are so careful and cautious, but once my wife and I were in great danger our elephant put her right fore foot into a deep hole in the ground. We were all thrown off. The mahout and I fell clear, but my wife when hurt her spine and even now, years later, feels the effect of that fall. She lay very close to the elephant, which was struggling to rise, and had I not pulled her away in time, she would have been crushed for, just as she got clear the elephant fell again, this time on its right side. A narrow escape indeed. Such accidents are fortunately rare for the sagacious beasts well know the danger of a fall. It was only after several attempts that our elephant was able to gain its footing on firm ground.

Being certain that one of the tigers in this beat would be the man-eater the mahouts asked that there should be two or three howdah elephants with the beating line; so I and the two M's said we would go across the stream. I made my way over with much difficulty, but M. Junior's elephant got firmly bogged. When M. Senior saw this he called out in his humorous way, 'I have seen what your elephant had to do to get across, and what I am seeing', pointing to his brother's elephant, 'persuades me not to attempt it, for one elephant', pointing to himself, 'on top of another elephant would certainly become permanently bogged; so good luck to you!' and off he went to join the line of howdah elephants which were being led to a crossing further down.

Following in single file along the bank of the stream, to a point beyond where the slain cow had been taken across into the long grass, the beating line turned left with myself on the left. It was very soon apparent that a tiger was before the line for several elephants were giving the usual signs. The tiger was not worried and carried on, as could be seen by the 'hullee', but after a while he began to move back and across and to grunt and growl to show his displeasure at being forced to move. The sounds he made did not indicate any intention to attack, but were merely warnings to the elephants not to tread on his tail!. Whenever the tiger came near me the mahout urged me to shoot, and even the head shikari, Phata, said I must kill the tiger or he would presently charge and get away after doing some damage. Such was the fear put into all these experienced men through the knowledge that a man-eater tiger was before them. As a matter of fact there was no more danger than from any other tiger with less evil reputation. The mahouts were very nervous and their fears were being communicated to their mounts, so it was apparent that I ought to take an opportunity, if one presented, and not adhere to the rather strict convention that no tiger may be shot from the beating line.

The elephants were closing on me in quarter moon formation, and after a time there was no movement to be seen as we were now in taller and more dense grass. Suddenly the tiger rushed from almost beneath my elephant but a little to the right. I could not see him but the mahout from his position on the elephant's neck was able to do so. Reaching back he placed his hand on mine clasping the howdah rail and directed attention to a place where the huge back of the royal beast was visible through the grass stems. The target was one I could not miss, and firing with the .280 the great beast pitched forward without a sound and rolled over on his right side. A number of mahouts called out to shoot again, and again, but I knew there was no need as when a tiger falls in his tracks without an answer to the shot it is certain he is dead. However, I fired two shots to satisfy them. The line continued to advance but there were no more tigers, though two in an adjacent cover had not been too much disturbed and were later driven out and shot. One of them charged the Raj Kumar, who was favoured on this shoot with all the charges! He charged repeatedly and fought to the end, being at last killed by one of the other guns as he was pursuing the Raj Kumar's retreating elephant. Had he caught up with it he would possibly have mounted behind and tried to get at the occupants of the howdah.

The Maharajah of M. had returned to the shoot and I was disappointed at having had to kill the tiger which should properly have been driven to him. The Rajah of G. ruled that I had been quite right, and congratulated me on getting this fine beast which measured ten feet over the curves in spite of having a very short tail. He was a very heavy, powerful beast and in his prime, having no apparent excuse for his evil taste for human flesh. That he was the man-eater is certain, for when we visited the place the following year it was found that all killings had ceased from the day he was shot. When the howdah and other elephants assembled round the dead tiger both sportsmen and beater mahouts cheered me, the demonstration being started by the Rajah, which was nice of him. The spontaneous and genuine gratification at my success was so sincere that I shall ever remember it. After ten days we left the camp; fourteen tigers had been shot. Twice in previous years the total killed amounted to no less than thirty-two. The total for this year was 18 tigers, three bears, two buffaloes.

Mention has been made of six tigers killed in one hour. That is not very remarkable in heavy grass jungle when a number of elephants are used; but a well-known official named D., a very fine rifle shot, on one occasion killed five tigers in less than one hour all by himself off a single pad elephant, and she untrained! This was not far from the town of Goalpara, and when he met us at Dhubri and told us about it, he said that there were perhaps another ten tigers collected there and he had desisted from attempting to kill more of the animals as the elephant was showing signs of fright, and no wonder! It is probable that this unusual assemblage was on account of a love-making affair and D was fortunate not to have been attacked as in such circumstances male tigers are most aggressive.

I have seen the wild Mithun in Assam, also the semi-tame mithun. The latter are met with in the Lushai Hills. There is a difference between the semi-tame and the wild Mithun in Assam. Neither of them are *wild* cattle like the Banting, or Tsine, of Burma. They are large, heavy animals. One day in the rainy season two of these beasts arrived at Dhubri and one was shot by Indians with 12 bore spherical bullets: the other got away. The mithun that was shot had two horns growing from one side of its head and one on the other side. None of the three horns were rudimentary ones, but well developed horns as is clearly seen in a photograph that was taken. I bought this head and gave it to the Rajah of G who had it set up, and no doubt it is on a wall in his palace to this day.

Other strange animals used to come into Dhubri. Perhaps they were carried down by the floods of the Brahmapootra and unable to land before getting to Dhubri, from which the jungles are far away. A clouded leopard was killed one year by Mr. K. the Pilot Superintendent of the river, with a shot gun. It was inside a drain, and much pleased was K when he found he had bagged such a rare and beautiful creature.

Bears.

I have been told by sportsmen, and have read the statement in many books, that a bear stands up to attack a man. I am talking about the sloth bear of India. One has to keep in mind that the same species may behave differently in various parts. What they do in Assam may be quite different to what they do in the Central Provinces and other parts of India.

In the Hill Districts of Assam, Naga Hills, Lushai Hills, Garo Hills, Mishmi Hills, Sadya Frontier Tracts, etc., I have spoken to many men who have been attacked by the sloth bear, and without exception all say that the bear does not stand up to attack, but rushes in, and after knocking the person down may attack the head and damage the scalp, but is just as likely to damage the thighs or whatever he can get hold of.

I have met about twenty cases, and they all told the same story of which the following is a typical example. An old Lushai man with some others shot at and wounded a bear with spherical bullets from a shot gun. Next morning they followed up, and the gun missing fire, the bear rushed into Luma and knocked him down. Then, as Luma attempted to get up, the bear bit him in the back, as well as the buttocks and also got hold of his right hand and bit off the thumb. Other Lushais then killed the beast with a spear.

I had once to give medical aid to a Survey Officer mauled by a sloth bear. He had been carried for about three days in an improvised bamboo litter by coolies and arrived about ten in the morning. He was in a dreadful state and the smell was so great that one could scarcely remain near the stretcher. We were at the Damra Inspection Bungalow so my wife at once prepared a bed;

and as I had practically nothing with me to treat such a case all I could do was to put permanganate poultices on the wounds to clean them up. After washing his person and dressing the wounds he was more comfortable and slept till the evening.

It was learnt from him that he had a black cocker spaniel, and when he saw a black object coming towards him in the grass was not prepared to meet the rush of a bear which took place before he could do anything with his gun. He was knocked over and the bear proceeded to bite his right thigh above the knee joint. He lost consciousness and on coming round shouted for the coolies who had all run away. The shouts brought the bear back and he was again attacked and put up his right arm to save his face. His arm was then badly mauled, also the left arm was bitten. He must have then again fainted, and on coming to his senses decided to make for a tree. As he got to the tree the bear again attacked, but passed along down the path and left him. He ran in the opposite direction and collapsed, the next recollection being that he was in the stretcher: and so he journeyed for three days, being kept alive on milk obtained from the villages. He remembered that while on the ground another bear stood by without attacking: this of course was a cub.

The wounds were neglected and serious. An injection of streptococcic serum was indicated but I had none with me. I drove the injured man 70 miles to Gauhati and from there sent him without delay to the Mission Hospital in Shillong. Later on I heard from him that his leg and right arm, which had received the most serious wounds, were healed and as well as ever; but the left arm, which was slightly mauled, was paralyzed.

Undoubtedly sloth bears are very dangerous animals and frequently attack without provocation, most of such cases being females with cubs at foot. They are particularly tough brutes, and soft nose bullet from a powerful rifle should be used against them.

Miscellaneous:

In regard to wild animals in Assam almost anything is possible, so when I met a young Mahomedan Assistant Surgeon at Fulbari, with a tale of a rogue elephant and a man-eating tiger, I quite believed his story, though I afterwards verified it through a report to the Deputy Commissioner. He had been ordered to make a Kala-azar survey of the villages within reach of the road between Tura and Fulbari. On reaching the first Inspection Bungalow of the two which are on that length of road, he was told by the chowkidar that a rogue elephant had on the previous night demolished the Subordinate's hut, so he decided to push on to the next Inspection Bungalow. Arriving there at about three in the afternoon he was informed by the chowkidar's wife that her husband had been caught the previous night near his hut by a tiger which had killed and eaten him! Some Garos of the neighbouring village had found the remains that very morning, so she was ready packed up to go to her home. The young Sub-Assistant Surgeon therefore went on to Fulbari, where I met him. He returned to

Tura, arriving there before I did, developed blackwater fever and died before my arrival. The treatment of blackwater with the leaves of *Vitex penduncularis* was not then known. It was originally discovered by Santhals. At first a liquid extract was issued by Government but proved useless. Then the method which proved successful, and may be deemed to be a specific, was adopted. This was to make from the dried leaves a strong 'tea', which may be taken with milk and sugar, of which a total of about a quart a day—usually three times a day—is given, but the total of the quart not exceeded. (*Vitex penduncularis* is a tree of the Botanical Order *Verbenaceae* and of the genus *vitex;* about fourteen species of which occur in India. In Assam the vernacular name is *Osai,* and in Santhal it is *Mara kata,* also *Bhadut.*)

The Kala-azar Survey was eventually completed and a hospital built near Tura. A village at a time was attended to, and in this way a large number of cures were effected with Dr. Brahmachari's treatment, which is certainly a cure. It was at one time thought that the common bug was the carrier of the disease, but it could not be proved that it was so. It has now been definitely proved that the true carrier of the disease is the sand fly *Phlebotomus argentipes.*

Doings at Dhubri :

Here is a true tale of a tiger and the Police at Dhubri. A tiger mauled a Police constable and was next day found in the compound of the Forest Officer, who was out of the Station. Mr. A. the Police Superintendent, ordered buckshot ammunition to be issued to the men. The tiger was seen in some bushes which ran along one side of the house and the Police opened fire. Meantime Mr. C. of my Service got on the roof of the bungalow and from the top verandah killed the tiger with one shot in the head. When the tiger was examined it was found that not one single buckshot had struck the animal! The only wound was Mr. C.'s bullet in the head. Mr. C. let the Police have the skin and it is perhaps still to be seen at the Dhubri Police Station. Mr. D., the Inspector-General of Police, was often ragged about this affair and asked how he was going to account for some seventy rounds of buckshot!

Here is another story concerning the Police. It also is a Dhubri tale—the tale of a Missionary's claim for a tiger skin. All officials were out of the Station on tour when some men reported to old A.M., Local Superintendent of Police, that a tiger was lying in the doorway of a cow-shed so that the cattle could not get out nor could the herdsmen approach. The old Officer took no interest in shooting but possessed a .405 Winchester rifle and a shot gun; and as there was no one else to destroy the tiger he considered it his duty to do so. Taking with him his weapons and a Police orderly he started off, passing the house of a Missionary on his way. The Missionary, learning what was afoot, also took a rifle and they went together to the village. Men pointed out the shed some seventy yards away and Padre B. said he could see the tiger so got on the roof of a hut. Old

Mahomed said it was too far and he would go closer to investigate, as all good Police officers do, and got within nine feet of the tiger which he could see the other side of a grass and mud wall of a broken down hut. He returned to the Padre and told him to come closer to the place where the animal was plainly visible. 'No' said the reluctant Parson, 'this is a better place'. So the old man returned to the nine foot ! stance to find his orderly with the shot gun had disappeared. Just as Mahomed was considering how best to poke his rifle barrel through the flimsy wall the Padre fired a shot which whizzed over his head ! The tiger now began to take notice so, as the old man afterwards related, he thought it time to act. Pushing his rifle barrel through he got a sight on the tiger's back and pulled the trigger. 'Then', said Mahomed, 'there was an earthquake, and the wounded brute flew round and round scattering bits of wall and shed in all directions. I found the tiger looking daggers at me so pointed the rifle at his head and this time he fell dead.' A bullock cart was procured and the tiger was being taken to Dhubri when the valiant Padre claimed the tiger as his property ! Just then the Deputy Commissioner returned from tour, and after hearing all the story and examining the tiger asked M. why he was giving up claim to the skin as, though the Padre said he could not have missed at seventy yards, it was impossible for the bullet fired from the top of the shed to have entered near the tail and traversed to the chest, and no other bullet hit the animal except those fired by M, 'Tell him the skin is yours.' The Padre was very angry and insisted he had hit the tiger and the skin should be his. At a tea party a few days later the Padre challenged old M to a shooting match saying that whichever of them made the best score should have it. 'Yes', said the brave old officer, 'we will shoot for it, and the range shall be nine feet and not seventy yards' ! No doubt this answer had been suggested to him. Every one was very indignant that the Padre fired a shot from so far when M. was so close to the tiger, as it was a dreadful thing to have done and might have cost old M his life.

S., who was with me when we shot a big buffalo, met with a sad end. He was then Forest Officer of the Goalpara District and in camp at Kochugaon. We knew him very well, and he had toured with us in the Garo Hills on many occasions. The telegram asked for urgent help so de C. and I set out in the Tin Lizzie to drive the fifty miles over bad roads and through forest. When I reached S. I was shocked to find he could not move, and after hearing what had happened soon discovered he had no sensation from the feet upwards to a point 1½ inches above the nipple line. This meant a high-up fracture, or dislocation, or both, of the spine; and also meant death. He was taken to the General Hospital, Calcutta, accompanied by his wife who left behind her Ayah and two babies. The younger of the children, then about six months old, is now an Officer in the Royal Navy.

S. had built several narrow gauge timber extraction line bridges over ravines, and returning over one of these the trolley wheels struck the obstrucion caused by one rail overlapping another by a quarter of an inch, the result being that the trolley overturned into the ravine. Mr. J., also on the trolley, fell first and S. on top of him and the trolley on S. So it would seem that the spine was fractured by the trolley as it descended. This would account for the double injury—the fracture and the dislocation.

A Panther Story :

On the Tura-Fulbari road there was an Inspection Bungalow, I have forgotten the name of it, the chokidar of which was killed and taken away by a tiger. For long after this occurrence it was said by the Garos living in those parts that a black tiger was killing people within a radius of twenty miles. It was probably a black panther. I have read in several books that black tigers exist in India, but never has the authentic death of one been recorded; so the question remains, 'Is there any such thing as a *black* tiger?' Whatever the correct answer, the Garo Hills 'Black tiger' was never bagged. I have not come across any explanation as to why there should not be black tigers as well as black panthers which are quite common where there are dense and damp jungles inhabited also by tigers.

Well, I went to this bungalow in connexion with Kala-azar. We arrived about tea time, and after tea I was talking to the Inspector of Vaccination outside the bungalow near some fairly heavy jungle, for the place is in the midst of forests. Suddenly a squirrel started to make a noise. We looked at one another for there is always a cause for bird and animal noises in the forest, and both of us knew that this meant the vicinity of either a tiger or a panther. I had just said we had better be getting inside when there was a rush towards us, and the animal came right to the edge of the cover. I caught hold of the Inspector to prevent his running, and we backed until we reached the bungalow steps—then we ran! I seized my .475 rifle and fired a shot in direction of the rush. As there was a large hole in the wall near to head of my bed it would have been foolish to sleep there, so I explored the Subordinates' Quarters and found a safe room to contain myself and all my staff and servants. It was rather a crush but had to be endured. Next morning it was found by the tracks that a panther had jumped a small stream and then made his rush. It was before he jumped the stream the squirrel had chattered at him.

When I related all this, later on to G. he ruled that it was only to get us out of the way that the panther had made his demonstration, his real objective being my pony tethered to a stake in the clearing to right of the bungalow. However that may be I still claim that it was a man-eating panther which contemplated making a meal of me!

(*To be continued*)

FIELD NOTES ON THE BIRDS OF THE ANAMALAI HILLS (COCHIN).

BY

C. R. STONOR.

The observations upon which this paper is based were made in the evergreen and deciduous forests of the north area of the Anamalai Hills, where these hills merge into the Nelliampathy Range, at an altitude of 1,500 to 2,000 ft., and between February 12th and March 11th, 1944.

That these notes are but fragmentary I am only too well aware; however, the very fact that it was possible within the space of a month to make observations hitherto unrecorded or at least unemphasised on the distribution, ecology, and natural history in general of a number of the wonderful jungle birds of South India, is in itself evidence of the vast and almost untouched field still lying fallow for the naturalist in this country. Certain features struck me as particularly noteworthy, and as crying out for scientific investigation; of these I give a few concrete examples :—

I was especially struck during my tour by the extraordinary social habits of so many of the *Timalidae*—the Babblers and Laughing Thrushes—birds which seem to have abandoned all individuality, and to have evolved a 'social system' wherein each and every member of a flock exists only as a minor unit within the group, to an extent far surpassing any other family of the Passerine birds.

Again, the discontinuous and 'patchy' distribution within a small area of forest shown by so many bulbuls is an ecological problem which would richly repay study, but which remains up to date quite unexplained.

To come down to a particular species; to know however slightly the Great Hornbill (*Dichoceros*) is to give it a unique niche in the community of jungle birds—yet we can pretend to no more than the most sketchy knowledge of any part of its ordinary everyday life.

Turning lastly to Courtship, Display, and the whole cycle of breeding activities, the strange trios which are such a feature of the Drongos are unexplained, the courtships of the Hoopoe, the Grey Hornbill, the Fairy Blue Bird, the Stork-billed Kingfisher, the whole family of the Pittas, the Barbets, and the Bee-eaters, remain totally unknown.

We know today the main details of the geographical distribution of the majority of Indian birds; we know the colour and number of their eggs, and the structure of their nest; but as for their Ecology, Breeding Biology, and Field Natural History in general, not only does plenty remain to be done, but not even the cream has been skimmed off.

All references to Sálim Ali refer to the 'Ornithology of Travancore and Cochin' by that author, published in the *Journal of the Bombay Natural History Society*, Vols. vii-ix (1935-7).

I am also indebted to Mr. Sálim Ali who has found time in the course of his tireless and relentless wresting of ecological information from Indian birds to edit these notes.

Finally, I am glad to record that the havoc said to be wrought by the aboriginal Kadar tribe on the avifauna of the hills, is certainly not true of the northern area, where their supine indolence is such that not even substantial remuneration could persuade them to help me look for nests.

LIST OF BIRDS

(Nomenclature according to 'The Ornithology of Travancore and Cochin').

PASSERES

Corvus macrorhynchos culminatus. The Southern Jungle Crow.

One at Parambikolam; the local forester was surprised when I pointed it out to him, and informed me that Crows are particularly unknown in this area.

Dendrocitta leucogastra. Southern Tree-Pie.

Very common in evergreen forest; but I never saw it in deciduous. The birds were always in pairs and rather tame—presumably breeding had not begun. They were extremely silent and although I watched many pairs, I never heard the call-note. They habitually came down to feed on *Lantana* berries. This pestilential plant is definitely become an important factor in the distribution of all fruit-eating birds.

Garrulax delesserti. The Wynaad Laughing Thrush.

I saw several parties, of from ten to thirty birds sneaking through the undergrowth in typical Babbler style. One party was in purely deciduous forest. They kept up a continuous low muttering, but even when I purposely alarmed them, did not break into the squeaks and gabbling customary in this family. I heard one call-note similar to the throaty 'chirp' of a fledgling of the true Thrushes.

Turdoides somervillei malabaricus. Malabar Jungle Babbler.

Very common in deciduous and mixed jungle only. I was watching a flock feeding one morning, when for no apparent reason one member fluffed out its plumage and shrieked and jabbered at the top of its raucous voice. In an instant every other member of the flock had stopped feeding and dashed to the spot, muttering and squawking. The originator of the disturbance quieted down, and the whole party moved off in another direction as if nothing had happened.

Pomatorhinus horsfieldi travancoreensis. Southern Scimitar Babbler.

Only once seen; a single bird in evergreen forest: apparently not very common in the area.

Ægithina tiphia multicolor. Ceylon Iora.

On March 7th, I saw the beautiful aerial display so well described by Hugh Whistler (Popular Handbook of Indian Birds, 3rd edition, p. 61); during the spiral descent with fluffed-out plumage, only the black and white colours seem to be used, and the yellow underparts are not at all obvious. It does not seem quite definite as to whether the display is aggressive or designed for the female. At the time when I saw it, there was a female nearby, but there was also another male in the same tree.

Chloropsis aurifrons insularis. Golden-fronted Chloropsis.

Fairly common, especially in mixed forest, and usually in pairs.

Molpastes cafer cafer. Red-vented Bulbul.

I found it only in one very restricted area at Parambikolam where I located a nest with three eggs on March 5th. Sálim Ali also recorded it as curiously uncommon in the hills. It was entirely absent at Kuriakutty in identical country only eight miles away.

I found bulbuls in general to be extremely patchy in their distribution; a species would be very plentiful in one area and apparently absent a few miles away; the ecology of this would be a very interesting study.

Otocompsa jocosa fuscicaudata. Southern Red-whiskered Bulbul.

Very common throughout the area—the only bulbul with continuous distribution.

Iole icterica. Yellow-browed Bulbul.

Common to abundance in a strictly limited area of evergreen and mixed forest at Kuriakutty. Mainly in pairs (up to Feb. 29th.) and breeding had apparently not begun.

Pycnonotus gularis. Ruby-throated Bulbul.

This very beautiful bulbul was abundant at Kuvallé, especially in the *Lantana* bushes, but was scarce elsewhere; it seemed rather to replace *Iole* and *vice-versa*. The white eye stands out very clearly in the field.

Copsychus saularis ceylonensis. Magpie-Robin.

The Magpie-Robin was fairly common in most places. I found it one of the shyest of birds, diving into undergrowth on the slightest alarm—a complete contrast to its behaviour in populated areas on the plains.

Geokichla citrina cyanotus. White-throated Ground Thrush.

Sparsely distributed throughout the area. Always solitary, and with a fondness for the recesses of the bamboo clumps.

Myophonus horsfieldi. Malabar Whistling Thrush.

Its school-boy whistle was all-pervading. Not only was it first up in the morning, but I often saw it feeding on the edge of clearings when almost dark in the evening. Always solitary.

Ochromela nigrorufa. Black-and-Orange Flycatcher.

Like Sálim Ali I failed to find it, although I looked for it particularly.

Tchitrea paradisea paradisii. Paradise Flycatcher.

Common everywhere, and nearly always alone. Even allowing for the greater conspicuousness of white-plumaged birds, I found adult males very much commoner than brown-plumaged birds. One of the few brown birds I saw was in a curious phase of plumage; entirely brown with the tail streamers fully developed and pure white. I saw one adult male taking insects off the surface of a pool-dancing over the water, and splashing his tail-streamers every time he swooped to take his prey.

Pericrocotus flammeus. Orange Minivet.

Common everywhere; and mainly in pairs or small parties up to March 10th.

Lalage sykesi. Black-headed Cuckoo-Shrike.

Only met with at Parambikolam, in deciduous forest, where it was in small, silent parties. I did not meet with *Graucalus* (a bird I know well in Assam).

Dicrurus longicuadatus longicaudatus. Grey Drongo.

I have only one or two doubtful identifications. I mention this since Sálim Ali describes it as 'replacing' the Black Drongo in hills and wooded areas.

Chaptia aenea malayensis. Southern Bronzed Drongo.

Very abundant everywhere and in all types of forest. I saw a bird on a nest on February 29th, and another chasing its much larger Racket-tailed relative.

Dissemurus paradiseus malabaricus. Malabar Large Racket-tailed Drongo.

This bird, always a joy to see, was abundant throughout evergreen forest and not unknown in deciduous. They were largely in small parties up to about the end of February, but by March 10th were mainly broken up into pairs. The curious trios which one so often sees among drongos of all species were a feature of the Racket-tail; it would be interesting to know something of their significance.

One evening I watched a mixed party of this and the Bronzed Drongo hawking winged termites. The Bronzed species circled round in horizontal flights while the Racket-tailed preferred a more vertical swooping and diving. I was quite unsuccessful in efforts to see how the tail rackets are used in display; but since the species is easy to observe, it is to be hoped that someone will take up the subject.

Irena puella puella. Fairy Blue-bird.

Among the commonest birds; they came down every afternoon from the high trees in noisy twittering parties, swarming through the *Lantana* bushes, the berries of which they have a great fondness for. During February they were in flocks, but by March were breaking up into pairs. While they were in parties, the males were much more in evidence than the females—not only from their brighter colouring—so that it is possible the two sexes may have slightly different habitats outside the breeding season. Also not uncommon in mixed forest and just extending into the edges of the deciduous zone.

A male Fairy Blue-bird feeding among the brilliant scarlet blossoms of an *Erythrina* tree is of all bird scenes in the jungle 'the loveliest and the best.'

Oriolus oriolus kundoo. Indian Oriole.

Abundant throughout the area and in all types of forest; always single or in pairs.

Gracula religiosa indica. Southern Grackle.

Perhaps the commonest bird in the area; they were in flocks up to the early days of March, when they were definitely breaking up into pairs.

Motacilla maderaspatensis. Large Pied Wagtail.

Only at Parambikolam and Kuriakutty. A bird carrying nesting material on March 7th.

Pitta brachyura. Indian Pitta.

Very scarce; I found the long dead remains of one bird at Kuvallé, and saw one at Parambikolam, thirty miles away on March 1st.

CORACIIFORMES

Macropicus javensis hodgsonii. Malabar Great Black Woodpecker.

Sálim Ali describes this species as confined to evergreen forest; but I also saw it in deciduous at Parambikolam. The call was a loud musical 'Clawk'—a call not typical of the woodpeckers.

Xantholaema rubricapilla malabarica. Crimson-throated Barbet.

A barbet of this genus was very common in evergreen forest; I was only able to get near one or two, and identified them as this species. I had been studying the Coppersmith (*X. haemocephala*) only a few days before coming up to the hills, and the call of the forest birds at once struck me as quite distinct in that it was more hurried, as if the producer was anxious to get it finished, and also had less of the metallic 'clang' of the Coppersmith. I am strongly of the opinion that most if not all the *Xantholaema* barbets of the area belong to the Crimson-throated species.

Hierococcyx varius. Common Hawk-Cuckoo.

Sálim Ali considers it as rather uncommon above 1,000 ft., and I fully endorse his opinion; I did not meet it at all in evergreen forest, and heard it occasionally by night in rather open areas near Parambikolam.

Centropus sinensis parroti. Southern Crow-Pheasant.

This peculiar furtive bird was common everywhere. To see it on a 'prolonged' flight-crossing a short stretch of open water with its big tail spread, and the little wings only just buoying it up, has a touch of the prehistoric about it, and gives a very fair idea of the flight of the fossil *Archaeopteryx*. It would be interesting to know if it is a weak flyer for anatomical reasons, or if a case of 'letting I dare not wait upon I would'.

Psittacula columboides. Blue-winged Parrot.

Common to abundance, especially in evergreen forest, but also in mixed and deciduous biotope. I think they were breeding in deciduous forest at Parambikolam. They habitually came down to feed on the *Lantana* bushes in close proximity to the Blossom-head (*P. cyanocephala*) but the two species never mixed, either in the bushes or when put to flight.

Psittacula cyanocephala. Blossom-headed Parrot.

Common in mixed and deciduous forest, especially at Kuriakutty, where Sálim Ali does not seem to have met with it.

Corocias benghalensis indica. South Indian Roller.

I often saw solitary birds, keeping well to the tree-tops in deciduous forest. They were quite silent, and never displayed. In most parts of South India breeding is in full swing by this time; and I am of the opinion that these were either non-breeding birds, or winter visitors from another part of the country.

Eurystomus orientalis. Broad-billed Roller.

This interesting Roller was common throughout the area, in all types of forest with an apparent preference for the mixed zone; and invariably in pairs. They kept to the edges of clearings, or along the river bed, in high, open trees, and in my experience never came near the ground.

One evening I watched a pair hawking a swarm of winged ants in company with a party of Grackles, the Rollers flying round and round in a large circle, twisting and turning in a Nightjar-like flight, and never moving out of the same small clearing.

Sálim Ali refers to its making sallies after winged insects, and I never saw it feeding on the ground like *Coracias*; so that it seems probable it takes all its food on the wing—for which its broad mouth, apparent even in flight, is well adapted.

It is interesting, especially in view of its very different appearance from the Blue Roller, that it has precisely the same series of calls as that species; the same harsh scream on the wing, and the same 'chark-chark' greeting call. All its calls are, however, on a higher and sharper note. I saw no display of any kind, although they were so closely paired off. When seen from below, the Broad-billed Roller has a very characteristic silhouette; its broad head, and relatively long neck jut out rather sharply in front of the wings; the light wing patch, and the orange bill also stand out clearly in the field.

Merops leschenaulti leschenaulti. Chestnut-headed Bee-Eater.

The fine Chestnut-headed Bee-Eater was quite common along open tracts throughout the area; always near water. They were solitary, in pairs, or small parties, and very silent. I saw no display or evidence of breeding. The chestnut head is not always obvious, but the creamy buff gorget, and sea-green of the lower back are good recognition characters.

I saw a bird of this species on March 21st in the centre of the town of Ernakulam—a strange locality for a forest bird. Perhaps on migration?

Alcedo atthis taprobana. Ceylon Common Kingfisher.

Sálim Ali and others describe the Common Kingfisher as uncommon in the hills. It was however quite plentiful on the streams and riverbed. I did not meet with the Pied Kingfisher (*Ceryle*).

Ramphalcyon capensis. Stork-billed Kingfisher.

The massive Stork-bill was present in pleasing abundance along the riverbeds. It has a penchant for flying straight through the fringing bamboos and small trees by the rivers—which it does with uncommon skill. Solitary or in widely separated pairs. In addition to its far carrying, and raucous laughter, I heard a completely different call—a loud, musical and rather mournful double note. Perhaps a breeding call?

Dichoceros bicornis. Great Indian Hornbill.

I put its density at roughly 1.5 pairs per square mile. The breeding season seemed to be just beginning, as I saw about equal numbers of pairs and solitary birds. I do not agree with Sálim Ali's suggestion that they suffer from the depredations of the Kadar tribe who relish the 'squabs'—I was unable to persuade them to help me look for a nest in spite of an offer of Rs. 10 for each nest located.

A very large male which was unfortunately shot for my benefit, was extremely fat and had the stomach crammed with small yellow figs. A solitary bird came three nights running to roost in deciduous forest at Kuriakutty, and seemed to be unmated.

It is hoped to publish a separate account of the natural history of this magnificent bird.

Hydrocissa coronata. Malabar Pied Hornbill.

Not very common. I watched a pair on the bare branches of a giant *Bombax* tree shortly after dawn on February 17th. The male was caressing the female, preening her neck, and every now and again hopping over her back to repeat the operation from the other side. She was passively submissive, and after a few minutes it culminated in pairing, following which the two flew off. They were both silent.

It is interesting to note that when a pair of the nearly allied African genus *Bycanistes* attempted to breed at the London Zoo in 1936, the same caressing of the female and jumping over her on the part of the male was the only courtship I saw.

Tockus griseus. Malabar Grey Hornbill.

Very common in all types of forest; sometimes feeding on *Lantana* berries. Almost always in pairs up to March 10th.

Upupa epops ceylonensis. Ceylon Hoopoe.

In deciduous forest only, where they were common; always solitary. From the general demeanour and since I never saw one carrying food, I do not think they were breeding, although this is the normal breeding season on the plains in South India. So possibly these birds were winter visitors. I had been watching the northern race in the Central Provinces some weeks previously, and found the richer colouring of *ceylonensis* very marked. The sight of a Hoopoe with its crest elevated and glowing orange from the evening sun shining though it makes its place in solar mythology abundantly clear.

Harpactes fasciatus malabaricus. Malabar Trogon.

Not uncommon in deciduous forest. Fairly tame, and at once recognisable, when the colours cannot be seen by its short 'flits' from tree to tree. Most were in female plumage.

Chaetura giganteus indicus. Brown-throated Spinetail.

A small flock of this splendid Swift was always to be seen at Kuriakutty. The speed and dash of a party 'balling' in the late afternoon when they regularly hurtled down almost to ground level, was literally frightening.

Hemiprocne coronata. Indian Crested Swift.

Only once seen; a small, noisy party in deciduous forest. In spite of its much emphasised resemblance to a Swallow, the long sickle curve of the wings at once proclaims its affinities in flight.

Lyncornis macrotis bourdilloni. Bourdillon's Great Eared Nightjar.

A very large Nightjar, both actually, and relative to others on the wing at the same time, regularly hawked over open ground at Kuriakutty. Its flight was the same as of the small species.

ACCIPITRES

Ictinaëtus malayensis perniger. Indian Black Eagle.

Common, and often flying through the lower branches of the trees in pairs; possibly a courtship flight.

Ichthyophaga ichthyaetus. Grey-headed Fishing Eagle

A single bird soaring over the forest on February 26th.

STEGANAPODES.

Anhinga melanagoster. Indian Darter.

Fairly common on the river in all areas.

HERIDIONES

Leptoptilos lavanicus. Lesser Adjutant.

A single bird on February 13th in a statuesque attitude on top of a very high dead tree in the foothills immediately East of Chalakudy.

Dupetor flavicollis. Black Bittern.

On March 3rd I came across a Black Bittern crouched by the side of a small open stream at Parambikolam. It remained flat on the ground until I was almost on top of it, when it darted away to cover.

Dutorides striatus javanicus. Indian Little Green Bittern.

A small heron, almost certainly this species was uncommon on the larger streams. They were always solitary, and usually flew up into a tree when disturbed.

THE FRESH WATER FISH AND FISHERIES OF AHMEDABAD.

BY

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AND

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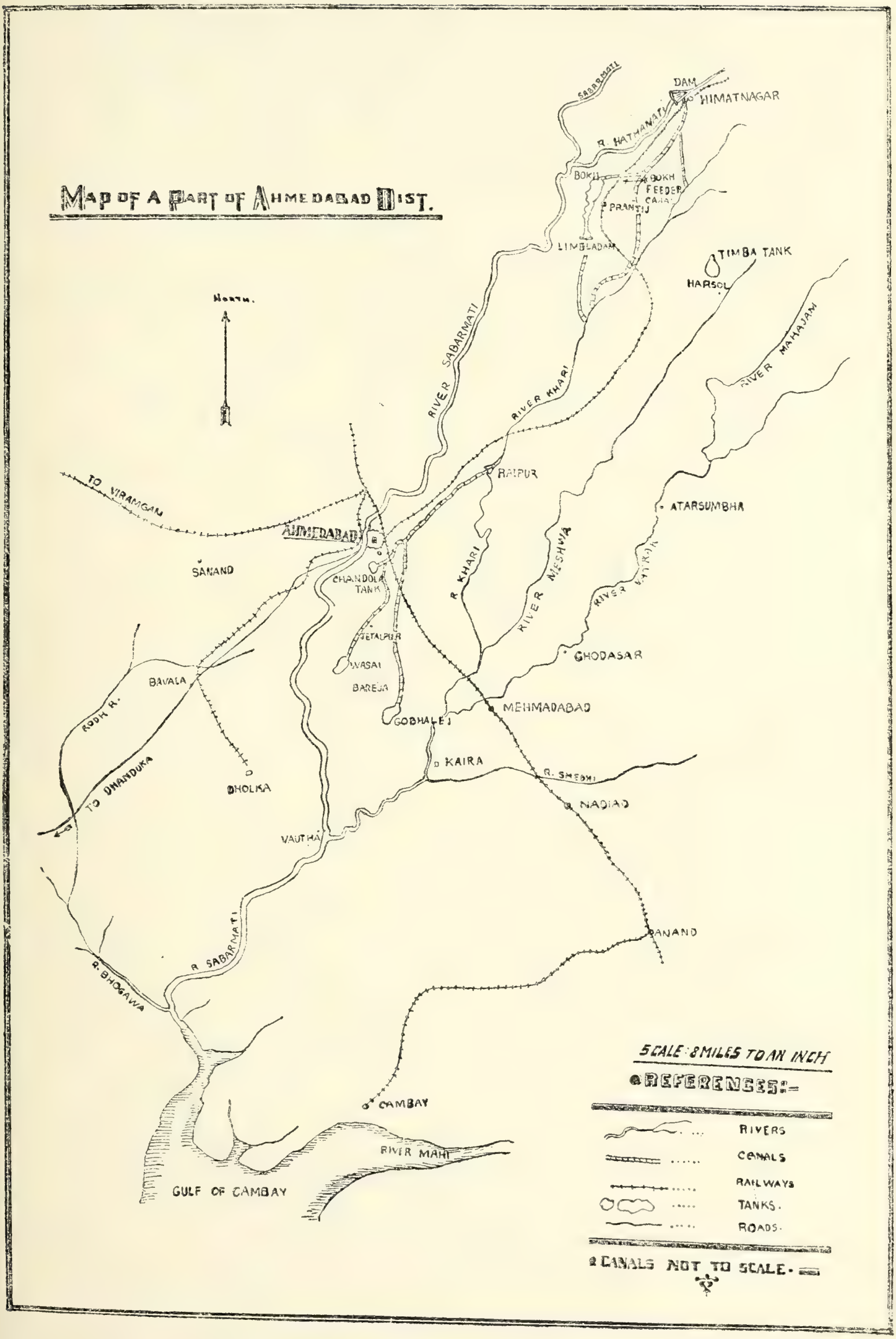
(*With a map*)

The richness of the fresh water fisheries of Ahmedabad district is not generally known, and was brought to light only recently after a survey of some of the sheets of fresh water there. Of all the districts in the Province of Bombay, Ahmedabad seems to be singularly fortunate in the availability of fresh water fish practically throughout the year. Its ponds and reservoirs are said to cover an area of more than 13,946 acres. The rivers and tanks in this area do not dry up to the same extent as in other parts of the province owing to the dams and canals in the upper reaches which regulate the supply of water. This probably accounts for the fairly even distribution of fish.

One reason that may explain the conservation of fresh water fish in the Ahmedabad district is the existence of restrictions prohibiting the catching of fish in several tanks. These restrictions are due in no small measure to the religious tenets of the Jains, which prohibit them from taking life. Their influence is also responsible for restriction on fishing even in such sheets of water as are not controlled by them. Besides the existence of tanks and ponds, another source of fish is the river Sabarmati on which is situated the city of Ahmedabad. The Sabarmati flows almost throughout the year, though in the hot weather it is little more than a stream.

Sources of Supply.—

Besides the Sabarmati, other sources for the supply of fish are the Rodh river across the Ahmedabad—Dhanduka road, and the Khari, Vatrak and Meshwa rivers on the eastern side. The catches in the rivers are, however, not large, and even if to these were to be added the catches in the Sabarmati, the total quantity would hardly be sufficient to meet the entire demand in Ahmedabad. Measures to increase the existing supplies will gradually become more imperative in view of the steadily growing population of the city, consequent on its industrial expansion, specially the increase


MAP OF A PART OF AHMEDABAD DIST.
North.
SABARMATI
DAM
HIMATNAGAR
R. HATHMATI
BOKH
BOKH FEEDER CANAL
PRANTIJ
LIMBLADAM
TIMBA TANK
HARSOL
RIVER SABARMATI
RIVER KHARI
RIVER MAHAJAM
TO VIRAMGAM
RAIPUR
ATARSUMBHA
AHMEDABAD
SANAND
CHANDOLA TANK
R. KHARI
RIVER MESHVA
RIVER VATRAK
JETALPUR
WASAI
BAREJA
GHODASAR
BAVALA
GOBHALEJ
MEHMADABAD
RODH R.
KAIRA
R. SHEDHI
TO DHANDUKA
DHOLKA
NADIAD
VAUTHA
ANAND
R. SABARMATI
R. BHOGAWA
SCALE 8 MILES TO AN INCH
REFERENCES:-
CAMBAY
RIVERS
RIVER MAHI
CANALS
RAILWAYS
TANKS.
GULF OF CAMBAY
ROADS.
CANALS NOT TO SCALE.

FISHERIES OF AHMEDABAD

in the number of textile mills. The present difficulties in regard to supplies are at present no doubt eased to some extent by imports from Prantij, Mehmedabad, Dholka, Sanand and Varaval, at all of which places fairly satisfactory catches are made. Prantij, 41 miles from Ahmedabad, is the site of the well known Bokh reservoir, which is considered to be a rich area for fishing, the catches being usually despatched by rail. Mehmedabad is situated along the river Vatrak, a tribuatary of the Sabarmati which it joins below Ahmedabad. Good fish is also available in pools in the Vatrak formed near the villages of Barapada, Atarsumbha, Ghodasar etc.

Veraval has long been noted for the richness of its marine fishes. The fishing season here is briskest in October and November, and small quantities are usually despatched to Ahmedabad, where there is always a ready market for fish. Import of fish from Veraval has considerably declined, however, of late owing to the curtailment of train services. Marine fish from Bombay and Bassein, therefore, find their way to this market only during the season. Ahmedabad is also occasionally served by supplies from Cambay which is situated on the sea.

Quantity and Variety of Fish.—

No regular statistics are available of the quantity of fish sold in Ahmedabad. This defect could easily be overcome as Ahmedabad has only one market for the sale of fish and the entire quantity obtained from various sources is sold there, apart from insignificant amounts peddled by hawkers. Inquiries in the market show that the present sales of fish average only about 10 and 50 maunds (daily during the slack and brisk seasons respectively). The sales might have been larger but for the comparatively high price at which fish is sold in Ahmedabad.

The variety of fish found in the Ahmedabad district is large, specially when one bears in mind that the rivers are not deep or long. Observations show that the medium sized fresh water fishes Cirrhina mrigala (Nagari) and Barbus (Tor) Mussullah (Bhasera) appeared to be most common. Next in order of abundance was Labeo fimbriatus (Bhilaji). Then followed Labeo rohita (Rohu), Wallagonia attu (Pahadi), Ophicephalus (Marrel), Mystus seenghala and Catla catla (Bavoos). There are, besides, other small fishes which are in equally good demand. A welcome variety from these fishes is provided by a large range of fresh water prawns (Palaemon sp.). These are available almost throughout the year and in specially fair abundance during the cold season. They grow to a large size.

A list of the fishes found in Ahmedabad, was published by Mr. H. G. Acharya in the *Bombay Natural History Society's Journal,* Vol. 40, p. 765. His list recorded 25 species, but the number falls far below the number contained in a list prepared by us. We have identified 46 different species.* These were collected at different times of the year, and the list might not yet be fully complete, as there may be other small fishes which we might not have come across. The list of the fishes found by us is given below with both scientific and local vernacular names.—

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* Labeo potail (Sykes), Cirrhina cirrhosa (Bloch.), and Barbus arulius (Jerdon) included in Acharya's list have, however, not been met with by us.

List of Fishes of Ahmedabad.

Scientific name.	*Local name.*
Order :—ISOSPONDYLI.	
Family :—Notopteridae.	
1. Notopterus notopterus (Pallas).	Patre, Patra.
Order :—OSTARIOPHYSI.	
Sub-order :—Siluroidea.	
Family :—Heteropneustidae.	
2. Heteropneusteus fossilis (Bloch.).	Shingi.
Family :—Siluridae.	
3. Callichrous bimaculatus (Bloch.).	Tamolana, Gongawaree.
4. Wallagonia attu (Bloch.).	Pahadi, Padin.
Family :—Schilbeidae.	
5. Clupisoma garua (Ham.).	Goongawaree.
Family :—Bagridae.	
6. Mystus cavasius (Ham.).	Katiya.
7. Mystus seenghala (Sykes).	Shingala.
Sub-order :—Cyprinoidea.	
Family :—Cyprinidae.	
Sub-family :—Abramadinae.	
8. Chela clupeoides (Bloch).	Chilli, Chal or Chaliya.
9. Chela phulo (Ham.).	do
10. Laubuca laubuca (Ham.).	Munaya.
Sub-family :—Rasborinae.	
11. Barilius bendelisis (Ham.).	Murakhi.
12. Danio devario (Ham.).	Melwa.
13. Rasbora daniconius (Ham.).	Munava.
14. Esomus danrica (Ham.).	Rajna.
Sub-family :—Cyprininae.	
15. Amblypharyngodon mola (Ham.).	
16. Barbus (Tor) khudree Sykes.	Bhasira, Kudna.
17. Barbus (Tor) Mussullah Sykes.	Bhasera Kudana.
18. Barbus (Puntius) sarana (Ham.).	
18*a*. Barbus (Puntius) chrysopoma (C + V).	Daraii.
19. Barbus (Puntius) ticto (Ham.).	Dhebari.
20. Barbus (Puntius) sophore (Ham.).	Dhebari.
21. Barbus (Puntius) arenatus (Day).	Dhebari.
22. Barbus (Puntius) vittatus (Day).	Dhebari.
23. Labeo ariza (Ham.).	
24. Labeo rohita (Ham.).	Rohu.
25. Labeo calbasu (Ham.).	Kanshi, Kalavat, Kalot.
26. Labeo fimbriatus (Bloch.).	Bhilaji.
27. Labeo dussumieri (C + V.).	Kursa.
28. Labeo boggut (Sykes).	
29. Labeo angra (Ham.).	Fattarchatu, Golachi or Goheri.

Scientific name.	*Local name.*
30. Cirrhina mrigala (Ham.)	Nagari.
31. Cirrhina reba (Ham.).	Murakhi.
32. Cirrhina latia Day.	Bhagana.
33. Rohtee cotio (Ham.).	Moyala.
34. Catla catla (Ham.).	Bavoos or Baas
Family :—Cobitidae.	
35. Lepidocephala thermalis (C. V.).	
36. Nemachilus botius (Ham.).	
Order :—SYNENTOGNATHI.	
Sub-order :—Scombresocoidea.	
Family :—Xenentodontidae or Belonidae.	
37. Xenentodon concila (Ham.)	Kutharva, Saravati, Kagada.
Order :—Microcyprini (Cyprinodontes).	
Sub-order :—Poecilioidea.	
Family :—Cyprinodontidae.	
Sub-family :—Fundulinae.	
38. Aplochilus blockii Arnold ... ... (= Panchax parvus S. Raj 1916).	Dindiya.
Order :—PERCOMORPHI.	
Sub-order :—Percoidea.	
Family :—Ambassidae.	
39. Ambassis nama (Ham.)	Chandava, Kathayya, Kathonja.
40. Ambassis ranga (Ham.).	
Sub-order :—Gobioidea.	
Family :—Gobiidae.	
41. Glossogobius giuris (Ham.).	Modu.
Sub-order :—Ophicephaloidea.	
Family :—Ophicephalidae.	
42. Ophicephalus punctatus Bloch.	Daku, Kadwa.
43. Ophicephalus striatus Bloch.	Marel, Saval.
44. Ophicephalus marulius Ham.	Marel, Saval.
Order :—OPISTHOMI.	
Family :—Mastacembelidae.	
45. Mastacembalus armatus (Lacep.).	Vam.
46. Mastacembalus pancalus (Ham.).	Ghepali.

Occurrence of Catla :

The presence of Catla in Ahmedabad, as recorded in the list, is a fact of the greatest significance, as the fish is invaluable for rural pisciculture. Its occurrence in Ahmedabad, along with Rohu and Mirgal, ensures a source of supply of fingerlings for fresh water fisheries elsewhere in the Bombay Province, and obviates the need, so long felt, of importing fingerlings from Patna, Madras etc.

The generally accepted view so far had been that Catla did not at all occur in the Bombay Province. Day, no doubt in his monumental work on the fishes of India, mentions that the fish is to be found throughout India, but the records and reports of subsequent investigators never confirmed the occurrence of the fish in the westerly flowing rivers of the Indian peninsula.

Sir Reginald Spence and S. H. Prater in their 'Game Fishes of Bombay' observed that the fish occurred in the Bombay Presidency, but did not mention the locality where it was available. Acharya (1939), in his list of fishes, referred to above, does not also mention this fish. The first reference to the fish is by Dr. S. T. Moses, Director of Fisheries, Baroda, who in 1941, included the fish in his 'Statistical Account of the Fish Supply of Baroda City.' His account contains the significant observation that the fish came from Mehmedabad. This area was accordingly continuously surveyed by the present authors, whose investigations have definitely established that the fish occurs not only in the Sabarmati but also in its tributaries Hathmati, Khari, Vatrak, Meshwa, and in the adjoining reservoirs.

Catla is a fish whose favourite habitat is wide and deep river. Now, the rivers round about Ahmedabad, cannot be considered to be deep. They are, in fact, shallow and small, but what has enabled the fish to overcome the disadvantages of this unfavourable habitat, are the dams constructed across the channels of the rivers. Fairly deep pools are usually to be found at the bases of such dams and weirs and they provide makeshift abodes for the fish until the rivers are again in spate. These pools enable the fish to survive and tide over the days of the fierce summer when the waters of the rivers otherwise almost dry up. Some of the natural reservoirs also fulfil the same purpose as the pools at the bases of the dams and weirs.

Bokh Reservoir.—

One such reservoir, namely the Bokh reservoir, at Prantij, (vide map attached) has been of inestimable value to the fisheries of Ahmedabad. Its perennial supply of water and its connection with the reverine system of northern Gujarat render it an important source of fish, particularly Catla, so much so that it is universally described in Gujarat as the home of Catla in that area. It is really a haven where fish can breed and are assured of plentiful water and adequate protection. The water all along the edge of the reservoir is comparatively shallow and thickly covered with *Typha* (Elephant grass or Bulrush). Moreover, such submerged plants as *Hydrilla, Ceratophyllum* and *Vallisneria* which are largely distributed over a wide stretch of water serve to impede fishing and afford good refuge specially to the baby fish. The Bokh has various remarkable features and its general appearance presents a fine problem in the physiography of the district. Here, it would not be out of place to refer to the description of the reservoir given in the Gazetteer of Ahmedabad district, which says: 'the Bokh, which literally means a fissure or chasm, is a broad and deep depression which begins near the meeting of the Hathmati and Sabarmati, and runs south through Prantij. It is a chain of pools and morasses, the largest sheet of water in it, called the large Bokh, being about 156 acres in extent and averaging 30 ft. in depth. The next in size, called the small Bokh, and lying opposite the town of Prantij covers about 35 acres and is said to average 4 feet in depth'.

The reservoir is at present roughly two and a half miles south of the Hathmati river, which evidently had in times gone by been a part of the river, coursing due south to join the Khari. Even now the reservoir is fed from the Hathmati by a canal which starts at Himatnagar, the water being led to the reservoir by a feeder channel from the main canal which ultimately joins the Khari. The overflow from the Bokh during the monsoon is impounded by the dam at Limbla, and this water which would otherwise have run to waste is during the latter part of the monsoon led into the Khari by a canal. The Khari itself is dammed at Raipur about 12 miles north east of Ahmedabad, and the impounded water is used to feed the network of tanks, e.g. Chandola, Kankaria, Gobhalej, Wasai, Aslali, Jetalpur etc. The Khari along with other rivers meets the Sabarmati lower down at Vautha. The entire Ahmedabad district is liable to severe floods during the monsoon when the rivers are in heavy spate. Aquatic life is thus distributed over the widely separated tanks and reservoirs by streams running from the heavily submerged tracks. Thus the Bokh is the link connecting the three main rivers of the area, namely, the Hathmati, Khari and Sabarmati. The Bokh was originally about 30 feet deep, but yearly has been becoming shallower as the silt which finds its way into it is not washed away during the floods. The dam at Limbla may perhaps in some measure be responsible for the siltage.

Breeding Grounds.—

The canals feeding the Bokh reservoir from the Hathmati provide during the time it is in flood an ideal nursery for fish from the reservoir itself to breed. The fish, which consists of such valuable carps as Catla, Rohu, Mirgal and Calbasu, has in flood times the ideal environment for breeding as its natural tendency at breeding time is to move upstream, the two feeder canals, from the Hathmati to the Bokh, serve as depositories for reproductory products of fish of the reservoir. These two stretches of water must evidently be the breeding grounds for in them have been noticed fingerlings of the aforesaid varieties of carps.

As the flood level in these two stretches of water subsides the fry and fingerlings are washed back into the reservoir, from which they later distribute themselves far and wide over the various rivers inter-connected as they are by network of canals.

Destruction of fish.—

Fishing in the Bokh is not prohibited, but is generally not vigorous during the major part of the year, the configuration of the reservoir presenting certain natural difficulties to the fishermen. The reservoir thus serves as a natural sanctuary for the fish. Both the reservoir and the feeder canal are not, however, equally safe to the fishes during the commencement of the monsoon, when they expose themselves to easy capture while they agitatedly move up the comparatively shallow waters of the feeder canals for breeding. A vivid description of the fate that befalls these fishes as they move up from the reservoir into the feeder canals and further upwards into the main canal from the Hathmati is contained in the Ahmedabad Gazetteer which records as follows:—

> 'In Prantij when flooded after heavy fall of rain, people swarm the Bokh wading about and with arrows tied in harpoon fashion with long string to their bows kill great numbers of fish. Fishing by torchfight is common, Kolis, Wagharies killing the fish by spearing and netting and Pendharias by beating with thick sticks. Damming, driving and poisoning with *Coculus indicus* are also practised'.

Such large-scale destruction of the parent fish before they have a chance to breed, is not without its effect on the supply of fish in the adjoining waters. This fact is also borne out by the observations of the local fishermen who state that the bigger varieties of carps such as Rohu, Catla, Mirgal, are now tending to diminish in numbers.

Remedial Measures.—

The only remedy to safeguard these fishes, which form in other provinces the mainstay of their piscicultural activities, and to conserve them for comestible purposes, would be to institute systematic control over the present injudicious and indiscriminate fishing in the Bokh reservoir and its environs at the commencement of monsoon. The present system of fishing in and around Ahmedabad is an inversion of the natural order. Fishing should be permitted in reservoirs at the dead ends of canals and in tanks into which fry find their way from the Bokh, for in such sheets of still water well-known carps like Catla, Rohu, Mirgal and Calbasu merely grow and fatten and do not breed. Fishing should, therefore, be allowed in only these sheets of still water, but actually it is forbidden there from religious considerations, a large section of the population being Jains, who are averse to the taking of life. The fish-eating public is thus deprived of a valuable item of food.

The present system of fishing helps neither the fish nor the public. Indiscriminate fishing is carried on in the Bokh and its feeder canals. This must be rigorously prohibited if an increase in the supply of fish is desired, for the Bokh and its feeder canals are in reality the nurseries where these fish rear, thrive and distribute themselves among the network of waterways—some ending in dead ends—which dot the district. The best and most effective protective measure to conserve the valuable carps would be the promulgation of a close season at the Bokh reservoir and its feeder canals for one month from the commencement of the monsoon. All tanks in the Hathmati and Kharicut canal system should be thrown open to fishing. These steps will not only enable the adult fishes to thrive and breed undisturbed in the Bokh and its feeder canals but also eventually facilitate a wider and more abundant distribution of fry in canals and tanks and thus increase the fish supply.

SOME NEW INDIAN *LITHOBIIDAE*.

BY

CAPT. H. J. C. LARWOOD, M.SC., F.Z.S., A.E.C.

(*With 4 text figures*)

While serving in India I have been able to make a small collection of *Myriapoda,* first around Dehra Dun, U.P., and then in Bundelkhand, C.I. It will readily be understood that service in the Army makes it difficult to investigate the collection adequately, and up to this time I have been able to consider only the *Lithobiidae*. The results are, however, of sufficient interest to merit a short note.

As late as 1892, Pocock stated[4] that none of this family had been recorded from India, although in 1890-91 he published an account[3] of two new species from Burma. In 1917 Silvestri[6] described four species and a variety of *Lithobius* from India (Assam, Darjeeling, N. Bengal and N. W. F. Province), and a new species of Henicopidae from Trichinopoly. His list did not include *Lithobius sculpturatus* which had been described[6] in the meanwhile by Pocock from Kodaikanal and Madras.

In his paper, Silvestri stated that although the fauna of India seemed to be poor in Lithobiidae, he considered that collecting in temperate regions would probably yield new forms. The truth of this is borne out by the following paper, although two of the present species come from a region which is scarcely temperate. It is worth noting, however, that both of these were taken under stones within 50 feet of the edge of a lake, and that one, *Lamyctes liani,* was found there only for a few days during the monsoon rains, and that the other *Archilithobius birmanicus* var. *chandellensis* could not be rediscovered after the winter rains had ceased. It would appear that both are very sensitive to humidity.

I wish to express my gratitude to the following gentlemen: Mr. J. C. M. Gardiner, Mr. A. E. Foot, Lt-Col. J. Steel Harvey, I.A., Dr. S. Higginbottom and above all, to Dr. Baini Prashad.

LITHOBIIDAE.

Lithobiinae.

Archilithobius glenniei sp. n. (Fig. 1 a-k)

Colour greenish-brown above, head and posterior segments of a more reddish hue, tergites somewhat mottled, legs and underside pale. Surface finely granulate.

Tergites 1, 3, 5 with postero-lateral corners rounded, posterior margin slightly emarginate; 2, 4, 6 short, posterior margin straight; 7 with subrectangular corners and posterior margin straight or slightly convex; 8, 10, 12, 14 tapering towards the rear, angles rounded, emarginate behind; 9, 11, 13 with posterior margin straight. Terminal segment rather semi-circular in outline, posterior margin only feebly emarginate. A distinct marginal furrow visible in tergites 1, 3 and 5 is less clear in succeeding segments.

Head slightly longer than broad; marginal furrow parallel to posterior margin. Ocelli seven in number arranged as in the figure. (In the Dehra Dun specimens there appear to be 8 ocelli.)

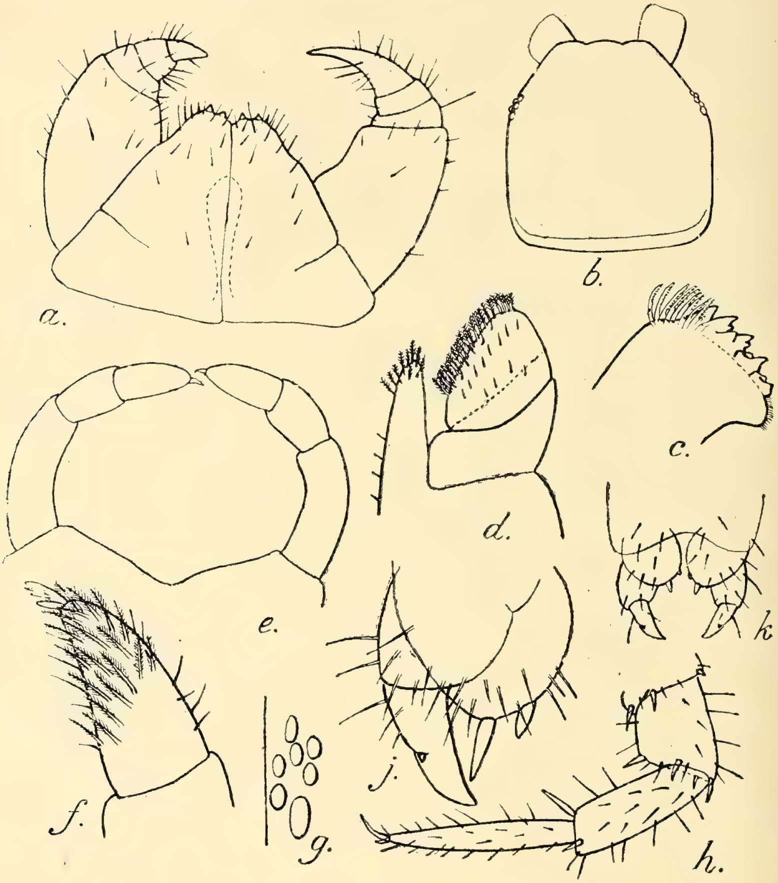

Fig. 1. *Archilithobius glenniei.*

(*a*) Forcipules (out claw undergoing regeneration); (*b*) head; (*c*) mandible; (*d*) 1st maxilla; (*e*) 2nd maxilla; (*f*) 2nd maxilla last segment; (*g*) ocelli, left side; (*h*) P. 1. distal part; (*j*) genital appendages of female; (*k*) genital Chakrata specimen.

Antennae: 20-23 segmented, setose, 10th segment 1½ times as long as broad, last segment twice as long as broad.

Mandibles of the usual form.

1st Maxilla: outer lobe fringed with about 23 plumose setae arranged in a double row; inner lobe surmounted by a dozen smaller plumose setae.

2nd Maxilla: terminal segment about twice as long as broad with some 30 plumose setae on the anterior face and non-plumose setae elsewhere. Claw with two spines and a small secondary claw.

Forcipules with 2+2 teeth and an additional seta on each side; precoxa narrowed distally, external margin concave.

Spinulation is of doubtful diagnostic value on account of the variation—which obtains—the opposite sides of the same specimen are occasionally found to be differently armed. For instance, the coxae of P 14 and P 15 of all specimens, bear a single spine, yet on one side of one specimen, two spines arise from a common base. The most usual armature, however, is as follows: P. 1. $\frac{0\ 0\ 1\ 2\ 1}{0\ 0\ 2\ 2\ 1}$ and P. 14. $\frac{1\ 0\ 3\ 2\ 0}{0\ 1\ 3\ 2\ 1}$. Only a single P. 15 was found and it was armed thus:—$\frac{1\ 0\ 3\ 1\ 0}{0\ 1\ 3\ 2\ 1}$. A minute secondary claw was present on all these appendages.

Genital appendages—female: external claw robust with the outer margin sinuate and a distinct tooth about midway. Internal lobe with two teeth, the outer about as long as the inner, but both robust. In the specimen from Chakrata, the inner tooth is less than half the size of the outer.

Genital appendages—male: rudimentary.

Coxal pores: 2 (or 3); 4; 4; 4 (or 3) small, circular.

Length: 11 mm.

Locality: 1 ♀ Mussoorie: under stone, shady 23 : 11 : 42. 7,000 ft.
2 ♂♂ Dehra Dun: under stone. Sept. 42. 2,200 ft.
1 ♀ Chakrata, from cave named Moila No. 2. Collected by Brig. E. A. Glennie. May 43.

This species is closest to *L.*(*A*). *tactus* Silv. and *L.*(*A*). *erraticulus* Silv. from Chitral (N.W.F. Province). From the former, it can be distinguished by (1) the fewer ocelli, (2) fewer coxal pores, (3) the form of the genital appendages of the female. The present species differs from *L.*(*A*).*erraticulus* in the following characters: (1) more numerous coxal pores; (2) the tarsi of P. 1-12 are not biarticulate as Silvestri[6] claims those of his species to be, although a pale transverse line is sometimes discernible across the mid-line of the tarsus; (3) the genital appendages of the female are of a different form—Silvestri makes no mention of the very conspicuous tooth on the outer margin of the external claw.

I have pleasure in naming this species after Brig. E. A. Glennie, D.S.O. The specimen taken by him from the Moila cave at Chakrata certainly belongs to this species in spite of the small deviation in the form of the female genital appendage referred to above. The chance migration of such lucifuge creatures into such an environment is not surprising.

Archilithobius sp. (Fig. 2 a-b)

Colour dark brown above, lighter beneath, head and last tergite orange; each tergite with the posterior border and middle line darker.

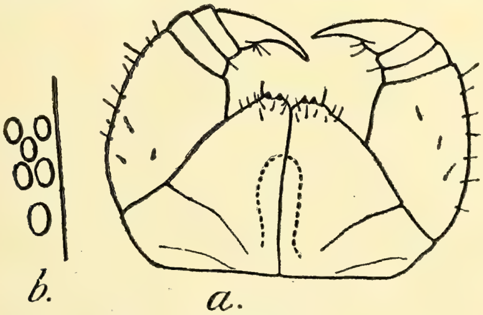

Fig. 2. *Archilithobius* sp.

(*a*) Forcipules; (*b*) Ocelli right side.

Tergites similar in form to *A. glenniei.*

Head broader than long, furrow parallel to posterior margin.

Ocelli: six, arranged as shown.

Antennae and mouth parts as for *A. glenniei* except that the last segment of 2nd maxilla has fewer plumose setae.

Forcipules: anterior margin convex, 2+2 teeth and seta; claw short.

Spinulation: P. 1. $\frac{0\ 0\ 1\ 2\ 1}{0\ 0\ 2\ 2\ 1}$; P. 14. $\frac{1\ 0\ 3\ 1\ 1}{0\ 1\ 3\ 2\ 1}$; P. 15. missing. P. 1. and P. 14 both have a small secondary claw. Coxae of P. 14 and P. 15 dorsal spine.

Genital appendages—male: rudimentary.

Coxal pores: 2; 3; 3; 3.

Length: 9.0 mm.

Locality.—A single specimen (male) of a species of *Archilithobius* was forwarded to me by Brig. Glennie. It was taken by Lt.-Col. G. N. Osmaston, R.E., near the top of Harimukh Mountain, Kashmir, at a height of 16,000 ft. in July 1943.

This specimen differs from *A. glenniei* in (1) the form of the head, (2) number of ocelli, (3) shape of forcipules and (4) number of coxal pores. From *A. erraticulus* Silv. it can be distinguished by (1) the fewer ocelli, (2) the form of the forcipules and (3) the presence in all legs of an undivided tarsus. Until further material is available it would be unwise to state anything more definite than that the example does not fit in with any previously described species.

Archilithobius birmanicus var. **chandeilensis** nov. (Fig. 3 a-f)

Colours Reddish-brown above, last tergite and underside paler. Surface rugose.

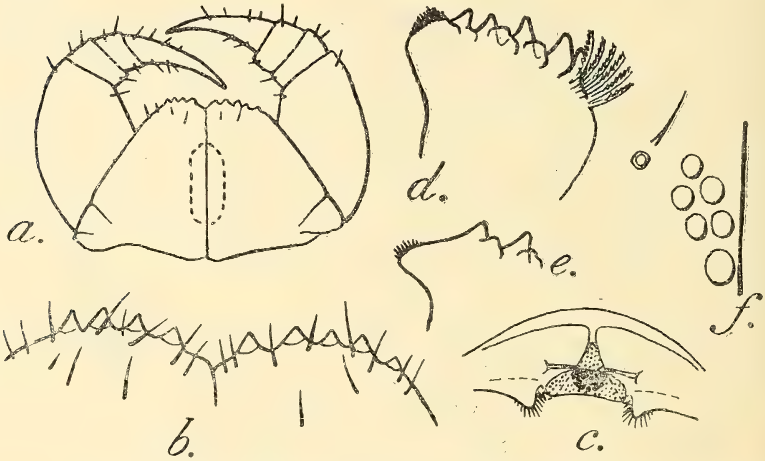

Fig. 3. *Archilithobius birmanicus* var. *chandellensis.*

(*a*) Forcipules; (*b*) Forcipules teeth; (*c*) labrum (foreshortened); (*d*) mandible; (*e*) mandible, another specimen; (*f*) ocelli, right side.

Tergites 1, 3, 5 with rounded postero-lateral corners, feebly emarginate; 2, 4, 6, 7 subrectangular with posterior margin straight; 8, 10, 12, 14 somewhat emarginate, with rounded corners and lateral margins increasingly convergent towards the rear; 9, 11, 13 straight, corners rectangular, not sharp. Head longer than broad; posterior marginal furrow broader in mid-line. Ocelli not very clear in the specimens examined; apparently 6 in number, arranged as in figure.

Antennae.—19-20-segmented, moderately setose, last segment 3 times as long as broad, 10th segment $1\frac{1}{2}$ times as long as broad.

Mandibles normal, teeth robust, with setose rectangular process on inner face. This process is, however, much reduced in another example.

1st Maxilla with about 15 plumose setae on the inner margin of the outer lobe and numerous plumose setae on the inner lobe.

2nd Maxilla.—Last segment with less than 20 plumose setae and furnished with a single claw with 3 processes.

Forcipules with broad, convex precoxa bearing 5+5 teeth (in one specimen 5+4); claw slender.

Spinulation.—P. 1. $\frac{0\ 0\ 3\ 1\ 1}{0\ 0\ 1\ 2\ 1}$; P. 14. $\frac{1\ 0\ 3\ 1\ 0}{0\ 1\ 3\ 3\ 0}$; P. 15. $\frac{1\ 0\ 2\ 1\ 0}{0\ 1\ 3\ 2\ 0}$

P. 14. and P. 15. have each a small secondary claw; part of limb distal to tibia with abundant small pores.

Genital organs of male rudimentary.

Coxal pores.—2 (or 3); 4; 4; 3.

Length.—8.0 mm.

Locality.—margin of Dhubelatal, near Nowgong (Bundelkhand), under stones, moist, with grass around. Jan. 43. 6 specs—all male.

Of the species recorded previously from the Indo-Australian region, only *A. sumatranus* Silv. and *A. birmanicus* Poc. have more than 3-4 teeth on the forcipules. The former has 7 and the latter 5-6. The present species is very close to *A. birmanicus*,—antennae, ocelli, tergites and coxal pores all agree with Pocock's description[3] which is brief and without figures. The chief points of difference are the number of teeth on the forcipules and the ventral armature of P. 15. (given as 1, 1, 1, 0, which I take to be 0, 0, 1, 1, 1, in the usual notation). As I have not seen the Burma specimens, and as there is no female in the present collection, I consider it more prudent to regard my specimens, for the time being at least, as belonging to a variety of *A. birmanicus*. Further collecting will no doubt elucidate the affinities of these species.

HENICOPINAE.

Attems lists 4 species and 1 variety of the genus *Lamyctes*:

(1) *L. africana* (Poc.)—S. W. Australia, Caffraria, Capland, Cameroons, St. Paul.
(2) *L. albipes* (Poc.)—Java.
(3) *L. emarginata* (Newp.)—New Zealand.
(4) *L. fulvicornis* Mein.—S. W. Australia, Europe, N. America, E. Africa.
(5) *L. fulvicornis* var. *hawaiiensis* Silv.—Hawaii, Kona.

The genus has not previously been recorded from India.

Lamyctes liani sp. n. (Fig. 4 a-j)

Colour reddish-brown; antennae, anterior part of head and hindmost tergite orange-brown. Underside pale. Surface finely granulate.

Tergites 1, 3, 5 with rounded postero-lateral corners, very slightly emarginate; 2, 4, 6, 7 with posterior corners sub-rectangular, posterior margin straight; 8, 10, 12, 14 with rounded posterior angles, distinctly emarginate, segments converging posteriorly; 9, 11, 13 with posterior margin straight. All tergites with a distinct marginal furrow.

Head about as broad as long; marginal furrow parallel to posterior margin.

Ocelli single, large, with purple pigment. [Traces of the same pigment were to be found scattered throughout the body, which is interesting in view of the fact that Chamberlin refers to the presence of a similar pigment in *L. Dolichopus* from Salt Lake County, N. America (Chamberlin, R. V. Proc. U.S. Nat. Mus. XXIV No. 1270, p. 798)].

Antennae almost reaching the posterior border of the 5th tergite; 29 segments, covered with short setae; last segment slender, 3-4 times as long as broad; 10th segment considerably broader than long.

Mandibles with conspicuous tooth at inner distal angle.

1st Maxilla of usual type: outer lobe fringed with 20 plumose setae; inner lobe with about 6 non-plumose setae.

2nd Maxilla—last segment with about 13 plumose setae; single claw with two lateral spines. [In his conspectus of the genus, (Naturh. Tidsskr. (3), V. 1868. p. 266) Meinert states that the setae are simple. This is not so in this species].

Forcipules with broad precoxal region; external margin obtuse-angled and slightly concave; apical margin with 3+3 teeth, the outermost on each side being considerably smaller than the other two.

Spinulation.—P. 1. $\frac{0\ 0\ 0\ 0\ 0}{0\ 0\ 0\ 0\ 0}$; P. 14. $\frac{0\ 0\ 0\ 0\ 0}{0\ 0\ 0\ 0\ 0}$; P. 15. $\frac{0\ 0\ 0\ 0\ 0}{0\ 0\ 0\ 0\ 0}$

On P. 1. there is a pseudo-spine formed by an extension of the integument of the dorsal side of the prefemur. Coxae of P. 14. and 15. without spine.

P. 1, P. 14. and P. 15. with small secondary claw. Legs are covered with numerous setae, but no pores occur. P. 1-12 with undivided tarsus, P. 13-15 with two-segmented tarsus, but division is not always well-marked.

First leg-bearing segment with spiracle.

Genital organs—female; basal segment with 2 elongated teeth, the inner shorter than the outer; terminal claw narrowed distally, markedly curved and with a longitudinal incision on the inner side.

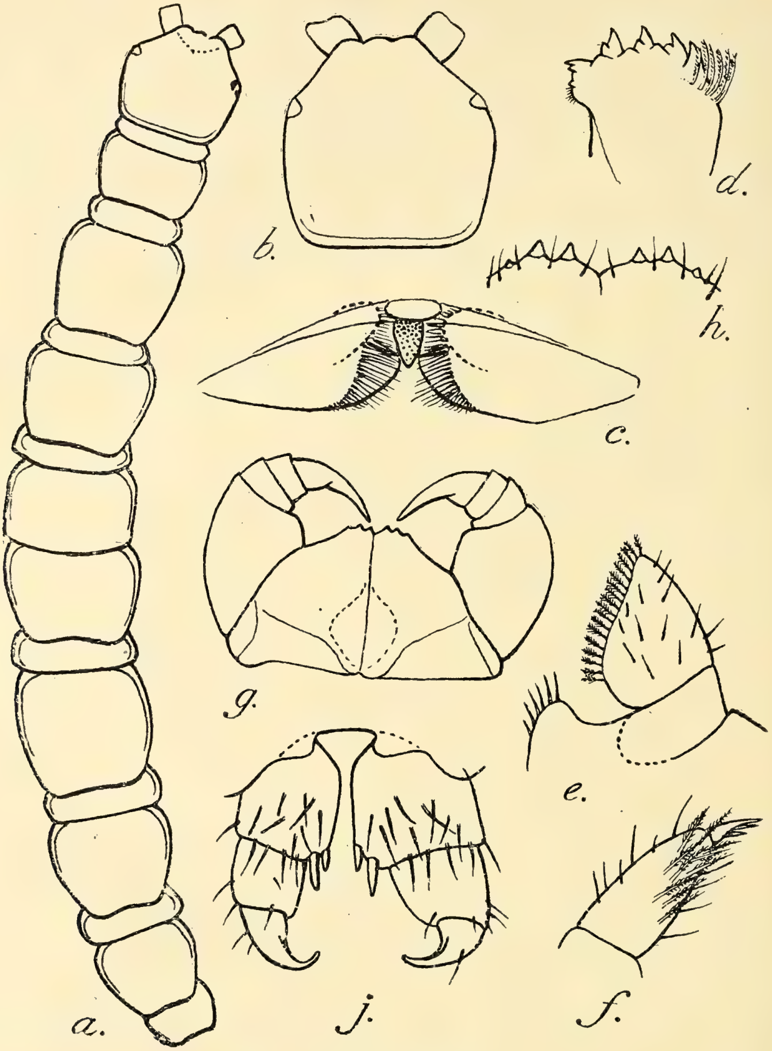

Fig. 4. *Lamyctes liani* sp. n.

(*a*) entire; (*b*) head; (*c*) labrum; (*d*) mandible; (*e*) 1st maxilla; (*f*) 2nd maxilla, last segment; (*g*) forcipules; (*h*) forcipules, teeth; (*j*) genital appendages of female.

Coxal pores: 2; 2; 2; 2; or 3; 3; 3: 3.

Length—7.0-8.0 mm.

Locality—margin of Dhubelatal, near Nowgong. Under stones, moist gravel 21st and 24th July 43.

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EXPLANATION OF FIGURES.

Fig. 1. *Archilithobius glenniei.*—(a) Forcipules (one claw undergoing regeneration), (b) head, (c) mandible, (d) 1st maxilla, (e) 2nd maxilla, (f) last segment of 2nd maxilla, (g) ocelli—left side, (h) P. 1, distal region of limb, (j) genital appendages of female, (k) the same, specimen from Chakrata.

Fig. 2. *Archilithobius* sp.—(a) Forcipules, (b) ocelli—right side.

Fig. 3. *Archilithobius birmanicus* var *chandellensis.*—(a) Forcipules, (b) teeth of forcipules, (c) labrum (foreshortened), (d) mandible, (e) mandible of another specimen, (f) ocelli—right side.

Fig. 4. *Lamyctes liani.*—(a) entire, (b) head, (c) labrum from below, (d) mandible, (e) 1st maxilla, (f) last segment of 2nd maxilla, (g) forcipules, (h) teeth of forcipules, (j) genital appendages of female.

ANNOTATED LIST OF CROP PESTS IN THE BOMBAY PROVINCE.

BY

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INTRODUCTION.

Economic entomology is very intimately associated with the crop production, therefore some knowledge of the more important pests is of the greatest significance. In the province of Bombay however, much attention could not be devoted to the study of various pests since the staff engaged was small and mostly occupied in teaching. Nevertheless, it has now been realised that the first essential necessity is to determine the identity and the activities of the insect foes, responsible for damaging our crops. The present publication therefore, aims at supplying such information to cultivators, garden-owners, district workers, propaganda officers, the revenue authorities, and also to students in the Agricultural College and schools, regarding the insects, found infesting various crops in our fields.

Additional data in the form of life histories, seasonal activities, nature and extent of damage and above all, the control measures, is highly desirable but must be deferred till first-hand information under local conditions, is available. Efforts are being made to remedy these deficiencies and the results of our further investigations will be published in the second contribution from this Department.

At present however, it is considered desirable that data should be available about the pests, responsible for the damage to various crops, and as far as possible about their seasonal activities. With this view an almost complete list of the pests of our province is arranged under crop heads, and brief notes appended.

Sugarcane.

Saccharum officinarum is planted in January to March and June and harvested from December to May.

A. Attacking sets and roots.

1. White ants—*Termes* sp. (*Termitidae*). Major pest all over the province. The workers tunnel into the roots to which the plants succumb.
2. Cockchafer—*Anomala varians* O. (*Rutelidae*). Minor pest, the grubs feed on the roots; active from April to June.

B. Leaf Feeding.

I. *Biting :*

1. Grasshopper—*Hieroglyphus banian* Fb. var. *elongata* (*Acridiidae*). Major pest specially in Deccan. Nymphs and adults feed on leaves; only one brood active from June to October.
2. Army worm—*Cirphis unipuncta* H. (*Noctuidae*). Major pest all over the province. Caterpillars move in swarms and feed on leaves; there may be two to three generations from June to November; hibernates as pupa in the soil.

II. *Sucking :*

1. White-flies—*Aleurolobus barodensis* W. and *Neomaskellia bergi* S. *Aleyrodidae* Minor pest practically all over the province. Nymphs feed on the sap which might result in withering of the leaves; active from July to December giving rise to formation of conspicuous black mould.
2. Leaf hopper—*Pyrilla aberrans* Kby. (*Fulgoridae*). Major pest all over the province. Nymphs and adults feed on the sap and cause withering of the leaves. 'Honey dew' secreted by the insects develops black mould which gives sooty appearance to leaves. Active from April to May and from August to February.
3. Mealy bug—*Trionymus sacchari* Gr. (*Coccidae*). Minor pest in Deccan. Nymphs and adults feed at the base of the leaves and consequently the crop loses vigour.
4. Black bug—*Assamia moesta* Westw. (*Fulgoridae*). Minor pest, probably active from July to December.

C. Borers.

1. Stem borer—*Argyria sticticraspis* Hamp. (*Pyralidae*). Major pest all over the province. The caterpillars bore into the stem and the plants in earlier stages may die; active from April to August during which period, three to four generations may occur.

2. Top-shoot borer—*Scirpophaga nivella* F. (*Pyralidae*). Minor pest recorded from Deccan area; caterpillars bore from the top and work downward; shoots may assume bunchy appearance.

3. Pink stem borer—*Sesamia inferens* W. (*Noctuidae*). Occasionally may assume the status of a major pest. Caterpillars bore into the stem; there may be 4-6 generations in a year; active from July to February.

Jowar.

Andropogon sorghum. Sown in June and September to November, and harvested from November to December and February-March. Fodder crop in March-June.

A. ATTACKING ROOTS.

1. White ants—Termites (*Termitidae*). Major pest. (vide *Sugarcane*).
2. Cockchafer—*Anomala varians* O. Minor pest. (vide *Sugarcane*).

B. LEAF FEEDING.

I. *Biting :*

1. Lucerne caterpillar—*Laphygma exigua* Hb. (*Noctuidae*). Minor pest; the caterpillars feed on leaves especially during the months of January and February.

2. Katra—*Amsacta moorei* B. (*Arctiadae*). Major pest, recorded in North Gujarat. Caterpillars defoliate all the plants. There is only one generation during June-July; hibernates as pupa in the soil.

3. Deccan wingless grasshopper—*Colemania sphenariodes* Bol. (*Acridiidae*). Major pest attacking crops only in Karnatak and Deccan. Both nymphs and adults feed on leaves, and there is only one generation from June to October.

4. White banded grasshopper—*Epacromia dorsalis* Thumb. (*Acridiidae*). Major pest in Deccan only. Both nymphs and adults feed on leaves and defoliate the germinating seedlings.

5. Surface grasshopper—*Chrotogonus lugubris* B. (*Acridiidae*). Major pest, recorded from all over the province. Nymphs and adults feed on leaves, and the pest is active almost throughout the year. It also damages various other crops such as Bajri, maize, etc.

6. Army worm—*Cirphis unipuncta* H. Minor pest. (vide *Sugarcane*).

II. *Sucking :*

1. Aphides—*Aphis maidis* F. (*Aphidiidae*). Major pest active from August—February. The insects suck the plant juice and the plants lose vitality. Various predators and black ants are always associated with the attack.

2. Green bug—*Nezara viridula* L. (*Pentatomidae*). Minor pest found on tender shoots and earheads. The attack is not very serious.

3. Jowar stem bug—*Pundaluoya simplicia* Dt. (*Fulgoridae*). Major pest, invariably found on the tender shoots. Nymphs and adults feed on the sap which results in withering of the plants; active from August—February.

4. Mites—*Paratetranychus indicus* H. Major pest which gives reddish or rusty appearance to the foliage; active from August—February.

5. Leaf hopper—*Pyrilla aberrans* Kby. Major pest. (vide *Sugarcane*).

C. BORERS.

1. Jowar borer—*Chilo zonellus* S. (*Pyralidae*). Major pest, practically all over the province. The caterpillars bore into the stem and cause the death of the plant in early stages. There are 4-6 generations from May to February.

2. Pink borer—*Sesamia inferens* Wlk. Major pest. (vide *Sugarcane*).

3. Stem fly—*Atherigona indica* M. (*Anthomyiidae*). Major pest all over the province; active from May to February. The maggots bore into the young seedlings and bring about their death.

D. GRAIN FEEDERS.

I. *Biting* :

1. Blister beetles—*Lytta tenuicollis* P. and species. (*Meloidae*). Adult beetles feed on blossom and do not allow them to develop into seeds; active from August to October.

2. *Khas* disease—*Contarinia andropogonis* F. (*Cecidomdae*). Minor pest. The maggots breed inside the tender ears as a result of which they are hollowed out; active during January—February.

II. *Sucking* :

1. Capsid bug—*Calocoris angustatus* L. (*Capsidae*). Minor pest. The nymphs and adults which are just like mosquitoes, feed on the sap as a result of which the grains get shrivelled; active from December—February.

Maize

Zea mays. Sown at any time, harvested 3-4 months after sowing.

A. ATTACKING ROOTS.

1. White ants—*Termites.* Major pest. (vide *Sugarcane*).

B. LEAF FEEDERS.

I. *Biting* :

1. Army worm—*Cirphis unipuncta* H. (*Noctuidae*). Major pest. (vide *Sugarcane*).

2 Deccan wingless grasshopper—*Colemania sphenarioides* B. Major pest. (vide *Jowar*).

3. Banded grasshopper—*Epacromia dorsalis* Thumb. (*Acridiidae*) Minor pest. (vide *Jowar*).

4. Katra—*Amsacta moorei* Butl. (*Arctiadae*). Major pest. (vide *Jowar*).

5. Surface grasshopper—*Chrotogonus lugubris* B. (*Acridiidae*). Minor pest. (vide *Jowar*).

II. *Sucking* :

1. Stem bug—*Pundaluoya simplicia* Dt. (*Fulgoridae*). Major pest. (vide *Jowar*).

C. BORERS.

1. Jowar borer—*Chilo zonellus* S. (*Pyralidae*). Major pest. (vide *Jowar*).
2. Pink borer—*Sesamia inferens* W. (*Noctuidae*). Major pest. (vide *Jowar*).

Wheat

Triticum vulgare. Sown in September to November and harvested from February—March.

A. ROOT FEEDERS.

1. White ants (Termites). Major pest. (vide *Sugarcane*).

B. LEAF FEEDERS.

1. Aphides. Major pest. (vide *Jowar*)

C. BORERS.

1. Jowar borer—*Chilo zonellus* S. (vide *Jowar*).
2. Pink borer—*Sesamia inferens* W. (vide *Jowar*).

Bajri.

Pennisetum typhoideum. Sown in June and harvested from September to October.

A. Root Feeders.—None.

B. Leaf feeders.

I. *Biting :*

1. Deccan wingless grasshopper—*Colemania sphenarioides* B. Major pest. (vide *Jowar*).
2. Katra—*Amsacta moorei* B. Major pest. (vide *Jowar*)
3. Army worm—*Cirphis unipuncta* H. Major pest. (vide *Jowar*).
4. Hairy caterpillar of Satara—Unidentified. Major pest. only recorded from this district. It is commonly known as 'Lodh'. Caterpillars feed on leaves and there is only one generation a year during July—August. The pest hibernates as pupa, in the soil.
5. Grasshoppers—*Chrotoganus* sp. and *Epacromia* sp. (vide *Jowar*).

II. *Sucking*: None.

C. Borers.

1. Jowar borer—*Chilo zonellus* S. (vide *Jowar*)
2. Pink borer—*Sesamia inferens* W. (vide *Jowar*).
3. Stem fly—*Atherigona indica* M. (*Anthomyiidae*) (vide *Jowar*.)

D. Grain feeders.

1. Blister beetles—*Lytta* sp., *Zonabris* sp. etc. (*Meloidae*). Major pest. (vide *Jowar*)

Paddy.

Oryza sativa. Sown in June; transplanted in July—August; harvested from November to January.

A. Attacking Roots.

1. Cockchafer—*Anomala varians* O. Minor pest. (vide *Sugarcane*).
2. Cockchafer—*Phyllognathus* sp. (*Dynastidae*). Minor pest.

B. Attacking seedlings.

1. Crabs—*Paratelphusa* sp. (*Crustacea*). Major pest in Konkan area. Both adults and young ones feed on the nursery as well as the transplanted seedlings. Their burrowing in the bunds causes leakage of water; active during the rainy season.

C. Leaf feeding.

I. *Biting* :

1. Swarming caterpillar—*Spodoptera mauritia* B. (*Noctuidae*). Major pest all over the rice growing tract. The caterpillars feed on rice and other grasses. Only one generation during June—August. The pest hibernates as pupa in the soil.
2. Army worm—*Cirphis albistigma* M. (*Noctuidae*). Major pest in Ratnagiri district. The caterpillars feed on leaves and the pest hibernates as pupa in the soil. There are 2-3 generations from July-September.
3. Rice hispa—*Hispa armigera* O. (*Chrysomelidae*). Major pest in Karwar and Belgaum districts. The grubs and adults feed on green matter and cause withering of plants. Both the *Kharif* and *Rabi* crops of paddy are attacked and damaged.
4. Blue beetle of Rice—*Leptispa pygmaea* B. (*Chrysomelidae*). Major pest in Karwar, Belgaum and Ratnagiri districts. Both grubs and adults feed on the green matter and the plants succumb to their attack. Both the *Kharif* as well as the *Rabi* crops are attacked and damaged.
5. Rice grasshopper—*Hieroglyphus banian* Fb. var. *elongata*. Minor pest. (vide *Sugarcane*).
6. Rice butterfly—*Melanitis ismene* C. (*Nymphalidae*). Minor pest. The caterpillars are occasionally found feeding on leaves.

7. Rice skipper—*Chapra mathias* Fb. (*Hesperidae*). Occasionally the caterpillars are found feeding on leaves.
8. Rice case worm—*Nymphula depunctalis* G. (*Pyralidae*). Minor pest. The caterpillars prepare cases from cut out leaf blades and feed when concealed in the rolls. These are semi-acquatic in habit and two generations are passed from June to August.

II. *Sucking:*

1. Rice leaf hopper—*Nephotettix bipunctatus* Fb. (*Jassidae*). Minor pest, only recorded from North Gujarat.
2. Rice mealy bug—*Ripersia oryzae* Gr. (*Coccidae*). Minor pest occasionally found in colonies on the stem under leaf sheaths. The attacked plants are practically devoid of vitality, appear sickly and generally wither out without developing earheads.

D. BORERS.

1. Rice stem borer—*Schoenobius bipunctifer* Wlk. (*Pyralidae*) Major pest. The caterpillars bore into the stem as a result of which the central growing leaf is killed. When the attack is at flowering stage the bearing is very poor and results in empty earheads. There are 3-4 generations from May to December.
2. Pink borer—*Sesamia inferens* W. Minor pest. (vide *Sugarcane*).
3. Rice gall-fly—*Pachydiplosis oryzae* W. (*Cecidomyidae*). Major pest, recorded from Belgaum, Karwar and Ratnagiri districts. The maggots bore into the stem as a result of which hollow outgrowths known as 'silvery shoots' are developed. Such plants do not bear earheads. The pest is active from May to December.

E. FEEDING ON EARHEADS.

1. Blister beetles—*Lytta* sp. and *Epicauta*. Sp. Minor pest. (vide *Jowar*)
2. Rice bug—*Leptocorisa acuta* Th. (*Coreidae*). Minor pest, damaging the earheads, met with in Belgaum and Karwar districts. Practically no grains are formed in the attacked inflorescence. Both the *Kharif* and *Rabi* crops are attacked.

Cotton.

Cossypium sp. Sown early in July-August, picking from December to March.

A. ATTACKING ROOTS.

1. White ants—*Termites*. (vide *Sugarcane*).

B. LEAF FEEDING.

I. *Biting :*

1. Lucerne caterpillar—*Laphygma exigua* H. Minor pest. (vide *Jowar*)
2. Surface grasshopper—*Chrotogonus* sp. Minor pest. (vide *Jowar*)
3. White weevil—*Myllocerus 11-pustulatus* var. *maculosus* Fst. (*Curculionidae*). Minor pest. Occasionally found feeding on the leaves. All the immature stages are found in the soil.
4. Bhindi caterpillar—*Acontia* sp. (*Noctuidae*). Minor pest. Occasionally green semi-loopers are found feeding on cotton leaves, the pest is active from June to October. The adult moths have bright lemon yellow wings.
5. Cotton semi-looper—*Cosmophila indica* Gn. (*Noctuidae*). Minor pest. The semiloopers are green but the adults have brownish wings. Considerable damage has been recorded to cotton leaves in Surat district.
6. Cotton semi-looper—*Tarache nitidula* F. (*Noctuidae*). Minor pest. Adults with white wings decorated with dark markings, semilooper dark brown, found damaging the leaves; commonly met with from June to October.
7. Cotton leaf roller—*Sylepta derogata* Fb. (*Pyralidae*). Minor pest occurring all over the province. Caterpillars lead a hidden life in the rolled up

leaves and feed on the green matter. There are 3-4 generations from June to December.

8. Cotton grasshopper—*Cyrtacanthacris ranacea* S. (*Acridiidae*). Minor pest. Both nymphs and adults feed on leaves from June to February.

9. Bud caterpillar—*Phycita infusella* M. (*Pyralidae*). Minor pest. The caterpillars are found feeding on buds and top leaves. This results in the fading of top shoots. Active from September to November.

II. *Sucking:*

1. Red Cotton bug—*Dysdercus cingulatus* Fb. (*Pyrrhocoridae*). Major pest, sucking the sap from the buds and bolls. Their feeding strains the lint. There are 5-6 generations from August to March.

2. Dusky cotton bug—*Oxycarenus loetus* K. (*Lygaeidae*). Major pest. The nymphs and adults are found feeding inside the bolls where quite a large number of these insects is seen at a time. There are 4—5 generations from October to March.

3. Cotton aphis—*Aphis gossypii* G. (*Aphidiidae*). Major pest. It is found on the under side of the leaves. The infested plants show poor growth or in severe cases they even wither away. The sooty mould develops on the 'honey dew' and interferes with photosynthesis. The pest is active from July to March.

4. Cotton jassid—*Empoasca* spp. (*Jassidae*). Major pest, found all over the province. The nymphs and adults feed on the sap and reduce the vitality of the plants. Breeding continues throughout the year. Active from July to March.

5. Mealy wings—*Bemisia tabacci* Genn. (*Aleyrodidae*). Minor pest. Both nymphs and adults feed on the sap and in some severe cases cause the withering of the plant. The pest is noticed in large numbers during November to March, malnutrition results in shedding of flowers and bolls.

6. Mealy bugs—*Pseudococcus* sp. (*Coccidae*). Minor pest. The fleshy insects covered over with cottony mass, feed on the sap. The pest is active from November to March.

7. Woolly mites—*Eriophyes gossypii.* Minor pest. These are found feeding on the stem and the underside of leaves. Usually these are found covered over with brown woolly fibers as the name indicates. Active from August to February.

C. BORERS.

1. Spotted boll worm—*Earias fabia* F. and *Earias insulana* B. (*Noctuidae*). Major pest. The caterpillars are black with white irregular patches. They bore into the top shoots, buds and bolls. The attacked bolls have punctures which are prominent because of the excreta; active throughout the season.

2. Pink boll worm—*Platyedra gossypiella* S. (*Gelechiadae*). Major pest; caterpillars, pink in colour, they bore into the bolls and feed on seed. Active from September to March.

3. Stem borer—*Sphenoptera gossypii* K. (*Buprestidae*). Minor pest. The grubs bore into the stem near the ground level and cause slight swelling. In serious cases the attacked plants may die.

Sann hemp.

Crotalaria juncea. Sown in June. Harvested from October to November.

A. ROOT FEEDERS—NONE.

B. LEAF FEEDERS.

I. *Biting:*

1. Sann leaf caterpillar—*Utetheisa pulchella* L. (*Arctiadae*). Major pest. The hairy caterpillars feed on leaves and defoliate the plants. Pupation either in the leaf folds or in the soil. There are 3-4 generations from June to September.

II. *Sucking:*

1. Leaf hopper—*Empoasca* sp. (*Jassidae*). Minor pest. (vide *Cotton*).

C. BORER.

1. Shoot borer—*Laspeyresia pseulonectis* Meyr. (*Eucosmirae*). Occasionally recorded as a minor pest. The caterpillars bore into the shoots and are active during July and August.

Tobacco.

Nicotiana tabacum. Seedlings raised from July to August; transplanted in September; harvested from January to February.

A. ROOT FEEDERS—NONE.

B. LEAF FEEDERS.

I. *Biting :*

1. Surface grasshopper—*Chrotogonus* sp. Minor pest. (vide *Jowar*)

2. Tobacco caterpillars—*Prodenia litura* F. (*Noctuidae*). Minor pest. Black and stout caterpillars are occasionally seen feeding on leaves. Pupation in the soil. There are 3-4 generations from September to January.

3. Cut worms—*Agrotis ypsilon* Rott. (*Noctuidae*). Black and stout caterpillars remain hidden in the soil during day and cut the plants near the ground level at night, and feed on the leaves. There may be 2-3 generations from August to October.

4. Brown cricket—*Brachytrypes portentosus* Licht. (*Gryllidae*). Minor pest. The adults cut the plants near the ground level and feed on them. Damage is serious during September.

C. BORERS.

1. Stem borer—*Gnorimoschema* (*Phthorimaea*) *heliopa* L. (*Gelechiadae*). Major pest. Small caterpillars bore into the stem and may cause the death of the plant. Two generations are passed in a season.

Potato

Solanum tuberosum. Planted in July and November; harvested in September and February.

A. LEAF FEEDING.

I. *Biting :*

1. Cut worm—*Agrotis ypsilon* Rott. Major pest. (vide *Tobacco*).

II. *Sucking :*

1. Leaf hopper—*Empoasca* sp. Major pest. (vide *Cotton*).

B. BORERS.

1. Tuber moth—*Gnorimoschema operculella* Z. (*Gelechiadae*). Major pest. Dirty white caterpillars bore into the tubers and occasionally the buds. Externally black excreta is seen at the eyes. There are about 4-6 generations throughout the year. The pest is more serious during the hot months.

Cucurbits.—Sown in June, October and February; harvested from time to time.

A. LEAF FEEDING.

I. *Biting :*

1. Pumpkin beetles—*Aulacophora abdominalis* Fb. and *Aulacophora excavata* Fb. (*Chrysomelidae*). Major pest. Red and black beetles are seen feeding on leaves which are badly damaged. The germinating seedlings when attacked are practically destroyed. The immature stages are found in the soil. The grubs cause appreciable damage by boring into the roots and stems as well as the fruits which come in contact with the soil. The pest is active from March to October.

2. Epilachna beetle—*Epilachna 28 puncta* F. and *Epilachna 12 puncta* M. (*Coccinellidae*). Major pest. The adults are orange coloured with 12 or 28 black dots on the body, while the grubs are hairy and both the adults and grubs feed on the underside of leaves. The adults eat leaf areas while the grubs feed on the leaf tissue, imparting ragged appearance. There may be 3 generations from July to September.

II. *Sucking :*

1. *Aphis malvae* K. Major pest. (vide *Jowar*)

III. *Feeding on flowers :*

1. Banded blister beetles—*Zonabris postulata* Thunb. Minor pest. (vide *Bajri*).

B. BORERS.

1. Fruit fly—*Chaetodacus cucurbitae* Coq. *Chaetodacus zonatus* S. (*Trypaenidae*). Major pest. White legless maggots bore into the fruits and cause their rotting. Pupation takes place in the soil. There may be 6 generations from May to January, but they overlap.

Cruciferous vegetables.

Both *Kharif* as well as *Rabi.*

I. *Leaf feeding :*

1. Diamond back moth—*Plutella maculipennis* C. (*Plutellidae*). Minor pest. Slender green caterpillars bite holes and feed on the foliage where they pupate. Active both on *Kharif* and *Rabi* crops.

2. Lucerne caterpillar—*Laphygma exigua* Hb. Minor pest. (vide *Jowar*)

3. Tobacco caterpillar—*Prodenia litura* F. Major pest. (vide *Tobacco*).

4. Mustard saw-fly—*Athalia proxima* K. (*Tenthredinidae*). Major pest. The grubs are black, which feed on the underside of leaves and drop down with the slightest touch. The damage is done by biting holes and skeletonising the leaves. Active from June to November.

Brinjal.

Solanum melongena. Seedlings raised in June—July, and October—December. Harvested when the fruits are ready.

A. LEAF FEEDING.

I. *Biting :*

1. Epilachna beetle—*Epilachna dodecastima* M. and *Epilachna 28 punctata* F. Minor pest. (vide *Cucurbits*).

2. Leaf roller—*Eublemma olivacea* W. (*Noctuidae*). Minor pest. The green caterpillar rolls the leaves and leads a concealed life. The pest is commonly met with in the winter crop.

II. *Sucking:*

1. Aphis—*Myzus persicae* S. Minor pest. (vide *Jowar*).

B. BORERS.

1. Stem borer—*Euzophera perticella* Rag. (*Pyralidae*). Minor pest. Caterpillars bore into the stem and may kill the plant. Generally attacks winter and summer crops. It is also recorded boring into tomato plants.

2. Fruit borer—*Leucinodes orbonalis* G. (*Pyralidae*). Major pest. Caterpillars pink, bore in the top shoots as well as the fruits which are rendered unremarkable. Winter crop is damaged severely. One generation may take 4-5 weeks.

Sweet potato.

Ipomoea batatas. Grown throughout the year.

A. LEAF FEEDERS.

I. *Biting :*

1. Hawk moth—*Herse convolvuli* L. (*Sphingidae*). Minor pest. The caterpillar is stout and grey, provided with an anal horn. It feeds on the leaves and damages them. Commonly met with from July to October. One life-cycle occupies 10-12 weeks; pupation in the soil.

B. BORERS.

1. Tuber weevil—*Cylas formicarius* Fb. (*Curculionidae*). Major pest. Both the adults and grubs tunnel into the tubers and cause their rotting. Occa-

sionally the vines may also be damaged which wither ultimately. The adults may also feed on the leaves.

Chillies.

Capsicum. Seedlings raised during June-July; transplanted July-August and harvested October-February.

A. Leaf feeders.

I. *Biting* :

1. Lucerne caterpillar—*Laphygma exigua* Hb. Minor pest. (vide *Jowar*).

II. *Sucking* :

1. Thrips—*Thrips tabacci* L. (*Thripidae*). Major pest. Minute, pale insects feed on the underside of leaves and cause their curling. In severe cases the plants absolutely wither out.

2. Mites—Major pest. Damage similar to that of thrips.

Betelvine.

Piper betel. Perennial crop. Plucked when ready for harvest.

A. Leaf feeders.

I. *Sucking* :

1. Leaf-bug—*Disphinctus maesarum* Kirk. (*Capsidae*). Major pest. Both the nymphs and the adults suck the sap from leaves as a result of which black spots appear. Active from June-December. Each generation may occupy 4-6 weeks.

OIL SEEDS

Groundnut.

Arachis hypogea. Sown in June-July: harvested during November-December.

A. Root feeders.

1. White ants. (vide *Sugarcane*).

B. Leaf feeders.

I. *Biting* :

1. Leaf roller—*Anartia ephippias* Meyr. (*Gelechiadae*). Minor pest. Caterpillars roll the leaves and feed inside.

II. *Sucking* :

1. Pod bug—*Aphanus sordidus* F. (*Lygaeidae*). Minor pest. Both the nymphs and adults suck the oil from the pods which give out rancid smell. One generation takes about 4-5 weeks. It is more a pest in the store than in the field.

Castor.

Ricinus communis. Sown in June or September; harvested in September and February.

A. Leaf feeders.

I. *Biting* :

1. Castor semi-looper—*Archoea janata* (*Noctuidae*). Major pest. Black caterpillars feed on leaves and skeletonise them. Active from June-October. One generation occupies 4-5 weeks. Pupation in the soil.

2. Hairy caterpillar—*Pericallia ricini* F. (*Arctiadae*). Minor pest. Brown hairy caterpillars feed gregariously on leaves. Active from June-October. Pupation in the soil.

3. Castor butterfly—*Ergolis merione* Cr. (*Nymphalidae*). Minor pest. The caterpillars feed on leaves, and occasionally may defoliate the plants.

4. Woolly caterpillar—*Trabala vishnu* Lef. (*Lasiocampidae*). Minor pest. Small woolly caterpillars feed on leaves during the *Kharif* season only. It is generally a sporadic pest.

5. Slug caterpillar—*Parasa lepida* Cr. (*Limacodidae*). Minor pest. The young larvae are gregarious, later on they live solitary life. The white shell-like cocoons are found clustered on stems.

II. *Sucking :*

1. Mealy wings—*Trialeurodes ricini* M. (*Aleyrodidae*). Minor pest. Nymphs feed on the underside of the leaves on which black mould develops. All the stages are found on the leaves during the growing period of the plants.
2. Leaf hopper—*Empoasca* sp. Minor pest. (vide *Cotton*).

B. Borers.

1. Shoot and capsule borer—*Dichocrocis punctiferalis* G. (*Pyralidae*). Occasionally a serious pest. Dark brown caterpillars bore and cut the tender shoots and also web the seeds. Pupation in silken cocoon in the shoot or capsule.

Sesamum.

Sesamum indicum. Sown from June, harvested from September.

A. Leaf feeders.

I. *Biting :*

1. Leaf roller—*Antigastra catalaunalis* D. (*Pyralidae*). Minor pest. Small greenish caterpillars with dark tubercles; roll up and web the leaves and may also bore in the shoots and pods. Considerable damage may be caused in the seedling stage. Active from July-September.

II. *Sucking :*

1. Pod bug—*Aphanus sordidus* F. (vide *Groundnut*).

B. Borers.

1. Gall-fly—*Asphondylia sesami* Felt. (*Cecidomyidae*). Minor pest. The adutls are like mosquitoes. The maggots bore into the flower buds or stem and produce gall-like structures.
2. Leaf caterpillar—*Acherontia styx* West. (*Sphingidae*). Minor pest. Stout and green caterpillars with anal horn, feed on leaves. There are two generations from July-December. Pupation in the soil.

PULSES.

Tur.

Cajanus indicus. Sown from July and harvested from December.

A. Leaf feeders.

I. *Biting :*

1. Aphis—*Aphis medicaginis* Koch. Minor pest. (vide *Jowar*).

B. Borers.

1. Pod borer—*Exelastes atomosa* W. (*Pterophoridae*). Major pest. The caterpillars are greenish brown, slightly hairy. They bore into the pods and feed on the seeds. Pupation on the pods. One generation occupies about 3-4 weeks.
2. Gram pod borer—*Heliothis obsoleta* F. Minor pest. (vide Gram).
3. Pod butterfly—*Catochrysops* (*Enchrysops*) *Cnejus* Fb. (*Lycaenidae*). Minor pest. Green slug-like caterpillars feed on pods and damage the contents.
4. Podfly—*Agromyza obtusa* M. (*Agromyzidae*). Major pest. The maggots bore into the seeds when they are green. Attacked pods present a shrivelled appearance. One generation occupies about 3 weeks.

II. *Sucking :*

1. Podbug—*Riptortus linearis* F. (*Coreidae*). Minor pest. Dark brown bugs feed on the sap from the pods and cause their shrivelling. Active from September-March.

2. Podbug—*Clavigralla gibbosa* S. (*Coreidae*). Major pest. Small sized bugs, brown in colour. There are 4-5 generations from November-March and each cycle may occupy about 4 weeks.

Gram.
Cicer arietinum.

A. LEAF FEEDERS.

I. *Biting :*

1. Cut worm—*Agrotis ypsilon* Rott. Major pest. (vide *Cruciferous vegetables*).

B. BORERS.

Pod borer—*Heliothis obsoleta* F. Major pest. The young caterpillars feed on foliage and when grown up enter the Pods and destroy the seeds. Pupation in an earthern cocoon in the soil. There may be 4-6 generations in a year.

Peas.
Pisum sativum.

A. LEAF FEEDERS.

I. *Biting :*

1. Lucerene caterpillar—*Laphygma exigua* Hb. (vide *Jowar*).
2. Tobacco caterpillar—*Prodenia litura* F. (vide *Tobacco*).

II. *Sucking :*

1. Aphis—*Macrosiphum pisi* Kalt. Major pest. (vide *Jowar*).

B. BORERS.

1. Pod borer—*Heliothis obsoleta* F. Major pest. (vide *Gram*).

Mung.
Phaseolus radiatus.

A. LEAF FEEDERS.

1. Hawk moth—*Herse convolvuli* L. Minor pest. (vide *Sweet potato*).

PEST OF FRUITS AND FRUIT TREES.

Mango.
Mangifera indica.

A. AFFECTING ROOTS.

1. White ants—*Termites* sp. Major pest. (vide *Sugarcane*).

B. LEAF FEEEDERS.

I. *Biting:*

1. Slug Caterpillars—*Parasa lepida* Cram. (*Limacodidae*). Minor pest. Caterpillars feed on leaves, mostly found on mango during December-March. Round shell-like cocoons are found in clusters on tree-trunks. The larval spines cause considerable itching if handled without covering the hands.

2. Leaf caterpillar—*Euthalia garuda* M. (*Nymphalidae*). Minor pest. Beautiful green caterpillars are observed feeding on the leaves. The pest may be found throughout the year.

3. Mango leaf webbing caterpillar—*Orthaga exvinaea* W. (*Noctuidae*). Minor pest. The caterpillars bind the leaves with silken threads and feed on green tissue. Often the damage is serious during August to March.

II. *Sucking :*

1. Mango hopper—*Idiocerus atkinsoni* L., *Idiocerus niveosparsus* L. and *Idiocerus clypealis* L. (*Jassidae*). Major pests. Both the nymphs and adults feed on the sap of tender leaves and inflorescence as a result of which the flowers fall off without setting any fruits. 'Honey dew' secreted by the insects develops sooty mould and imparts blackish appearance to the plants. Breeding takes place twice during December-February and June and July. One generation occupies about 2-3 weeks.

2. *Coccids.* Major pest in three species. Both the nymphs and adults feed on sap. They cover the fruits and twigs in serious cases. Their presence attracts red ants.

C. BORERS.

I. *Soot borers :*

1. Mango shoot borer—*Chlumetia transversa* W. (*Noctuidae*). Major pest. The caterpillars bore into the growing shoots. Young grafted seedlings are severely damaged and may even be killed. Active from July—December.

2. Leaf and twig miner—*Acrocercops* sp. (*Gracillariadae*). Minor pest. The caterpillars attack very young leaves and fresh twigs. In case of seedlings some damage takes place. Active from November-April.

3. Castor capsule borer—*Dichocrocis punctiferalis* G. Minor pest. (vide *Castor*).

II. *Stem borers :*

1. Mango stem borer—*Batocera rubus* L. (*Cerambycidae*). Major pest. The grubs bore into stems or branches as a result of which the plant may ultimately die. The pest is active throughout the year, one generation may take more than 12 months.

2. Branch borer—*Arbela tetraonis* M. (*Arbelidae*). Minor pest. The caterpillars occasionally bore into the branches and cause their death. It attacks various other trees besides mango.

III. *Fruit borers :*

1. Fruit flies—*Chaetodacus ferrugineus* F. and *Chaetodacus zonatus* S. and varieties of *Chaetodacus ferrugineus.* Minor pests. The maggots bore into the ripening fruits and render them useless for consumption. Pupation takes place in the soil. There may be 2-3 generations during the mango season. They also attack many other fruits.

D. GENERAL PESTS.

1. Red ants—*Oecophylla smaragdina* Fb. (*Formicidae*). They do not cause any direct damage to the plant but indirectly protect the coccids and white flies and cause their spread all over the plantation which results in considerable damage. They are also a nuisance at the time of harvest.

Pomegranate.

Pumica granatum.

A. ROOT FEEDERS—NONE.

B. LEAF FEEDERS.

I. *Biting:*

1. Castor semilooper—*Archoea janata* L. (*Noctuidae*). Minor pest. The caterpillars are black which occasionally feed on leaves and defoliate the plants. Pupation takes place in the soil. The pest is active from June—December, during which period 3-4 generation are passed.

II. *Sucking :*

1. *Aphis.* Minor pest. Both the adults and nymphs suck the sap especially from tender shoots and reduce the vitality of the plants. Active practically throughout.

2. *Coccids.* Minor pest. Both the nymphs and adults feed on leaves and tender shoots and in serious cases the plants may wither.

C. Borers.

1. Fruit borer—*Virachola isocrates* F. (*Lycaenidae*). Major pest. The caterpillars are black which bore into the fruits and render them inedible. The damage continues throughout the year and one generation occupies about 4—6 weeks.

Citrus.

Citrus sp.

A. Root feeding.

1. White ants—*Termites* sp. Minor pest. (vide *Sugarcane*).

B. Leaf feeding.

I. *Biting:*

1. Lemon butterfly—*Papilio demoleus* L. (*Papilionidae*). Minor pest. The caterpillars are green in colour and feed on leaves. In nurseries the seedlings may be absolutely defoliated. The pupae stick to the leaves, and the adults are noticed throughout the year.

2. Leaf miner—*Phyllocnistis citrella* S. (*Lyonetiadae*). Minor pest. The caterpillars mine the leaves and feed in between two epidermal layers. The damage continues throughout the year.

II. *Sucking:*

1. Coccids—*Chrysomphalus aonidum* Riley, and *Pseudococcus citri* R. Major pests. Both leaves and fruits are attacked. The infested fruits lose attraction. The second species may also attract the red ants.

2. White flies—*Dialeurodes citri* A. (*Aleyrodidae*). Major pest. Black nymphs are seen feeding on the underside of leaves. 'Honey dew' secreted by the pest develops sooty mould which interferes with the photosynthesis. Active from October—February.

3. Aphis—*Toxoptera aurantii* Boy. Major pest. Both the adults and nymphs feed on the sap of growing shoots and in severe cases the growth of the plant is considerably checked. Active practically throughout the year.

C. Fruit sucking.

1. Fruit sucking moths—*Ophideres fullonica* L. and *Ophideres materna* L. (*Noctuidae*). Major pest. The caterpillars feed on some wild plants. The adults are the real pests since they puncture the fruits and feed on the juice. The fruits thus damaged begin to rot and drop down. Active from July to October.

D. Borers.

1. Fruit fly—*Chaetodacus ferrugineus* F. and *varieties*. Minor pest. (vide *Mango*).

2. Red ants—*Oecophylla smaragdina* F. Major pest. (vide *Mango*).

Guava.

Psidum guava.

A. Leaf sucking.

1. Mealy bugs—*Pulvinaria psidii* M. (*Coccidae*). Major pest. The nymphs and adults feed on leaf sap. Sooty mould is developed on the 'Honey dew' secreted by them and the entire plant becomes black and sticky.

B. Borers.

1. Stem borer—*Arbela tetraonis* Mo. Minor pest. (vide *Mango*).

2. Castor capsule borer—*Dichocrosis punctiferalis* G. (*Pyralidae*). Minor pest. (vide *Castor*).

Grapevine.

Vitis vinefera.

A. Leaf feeders.

I. *Biting:*

1. Leaf beetle—*Scelodonta strigicollis* Mots. (*Chrysomelidae*). Major pest. The adults feed on growing shoots and leaves. They resemble 'Udid' grain and therefore known as *Udadya beetles*. The immature stages are passed in the soil and the damage after October pruning is most serious.

2. Cockchafer beetle—*Adoretus ovalis* Bl. Minor pest. (vide *Sugarcane*).

II. *Sucking:*

1. Thrips—*Rhipiphorothrips cruentatus* H. (*Thripidae*). Minor pest. The nymphs and adults feed on leaf sap and in severe infestation the shoots may wither away.

Plantain.

Musa sapientum.

A. Leaf feeders.

1. Tobacco caterpillar—*Prodenia litura* F. Minor pest. (vide *Tobacco*).

2. Hairy caterpillar—*Pericallia ricini* F. (*Arctiadae*). Minor pest. Brown hairy caterpillars feed gregariously on the leaves. Only one generation attacks the plantation during July and August.

B. Borers.

1. Stem and root borer—*Cosmopolites sordidus* G. (*Curculionidae*). Minor pest. Dirty white, legless grubs bore into the roots and stem. The adults are black with a conspicuous snout. Breeding takes place throughout the year.

Coconut palm.

Cocos nucifera.

A. Leaf feeders.

I. *Biting:*

1. Black headed caterpillar—*Nephantis serinopa* M. (*Xyloryctidae*). Major pest. The caterpillars prepare galleries of their own excreta and lead hidden life on the underside of leaves. The damaged leaf appears as if scorched One generation occupies about 5-6 weeks. Active during the monsoons.

B. Borers.

I. *Soot borers:*

1. Palm beetle—*Oryctes rhinoceros* L. (*Dynastidae*). Major pest. Adults are black beetles with a horn-like projection on the head, shining above and hairy below. They bore into the growing shoots and kill the fronds. The immature stages are met with in the manure pits. Only one generation in a year.

1. Palm weevil—*Rhynchophorus ferrugineus* F. (*Curculionidae*). Major pest. The adult is reddish-brown weevil. The grub bores into the growing shoots and damages them seriously.

FRESHWATER ALGAE NEAR BOMBAY.

I. The Seasonal Succession of the Algae in a Tank at Bandra.

BY

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and

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(With 5 graphs and 8 plates)

INTRODUCTION.

The immensity of the field of algal ecology and the diversity of its problems have been recognized by most algologists, who also emphasize the value of one aspect of the subject, *viz.* prolonged periodical observation of the algal flora of any piece of water. This is very necessary, since algal species are known to appear and disappear with startling rapidity.

Fritsch (1906, 1907) was the first to indicate the lines along which research in algal ecology would be useful. Later, with Rich, in a series of papers (1907, 1909, 1913), they pointed out that small bodies of water such as pools and ponds are very suitable for demonstrating the relations between external conditions and algal growth, as they readily react to changes in the meteorological and other conditions.

Among other contributors to the subject were Transeau (1913, 1916) who made continuous records, extending over a number of years, of algal conditions in Central Illinois and Griffiths (1916, 1922, 1923, 1925-27, 1927), who made an attempt to elucidate the factors determining the composition of the water solution of pools in different parts of England, and consequently the occurrence of the plankton. Similar studies were made by Hodgetts (1921, 1922), Atkins and Harris (1924, 1925), Howland (1931), Lind (1938) and others.

Though Iyengar (1928, 1938), Biswas (1932) and Ghose (1933) have all stressed the need for such work, the only contributions from India so far have come from Pruthi (1933), who worked on the seasonal succession of the algal flora of an artificial tank in Calcutta, and correlated the occurrence of the different species with the physical and chemical condition of the water, Ganapati (1940, 1941, 1943), who worked on the same lines in Madras, and a few others.

In India however, owing to the diverse climatic conditions, the inferences drawn at one place will not be applicable to another. It

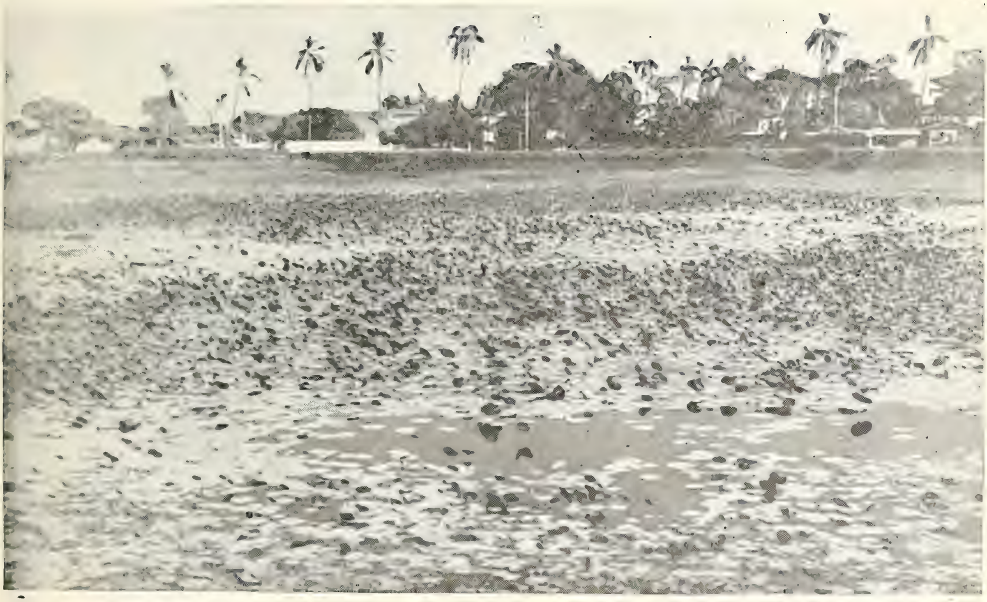

Photo 1. Monsoon aspect of Bandra Tank.

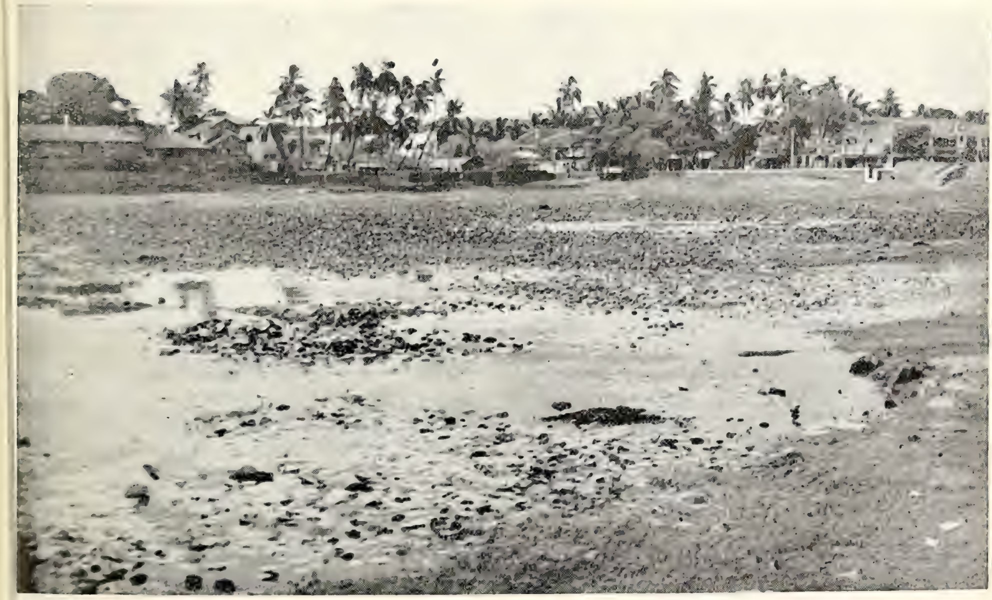

Photo 2. Dry Season aspect of Bandra Tank.

Bombay Algae

was therefore decided to study the algae of the ponds around Bombay systematically for at least a year, and to correlate the quantity and nature of the algae present in the different seasons with the chemical and physical features of the water and the prevailing meteorological conditions.

DESCRIPTION OF THE TANK.

The first piece of water selected for study was a tank situated at Bandra to the north of Bombay. It is known as the Motha Tank (*Bombay Gazette*, 1882) and is close to the railway station. It is approximately six acres in area and roughly quadrilateral in shape (Fig. 1). On its western and eastern sides, it is bounded by public roads. To the south is a by-lane, on the other side of which are a number of huts, whose occupants make free use of the

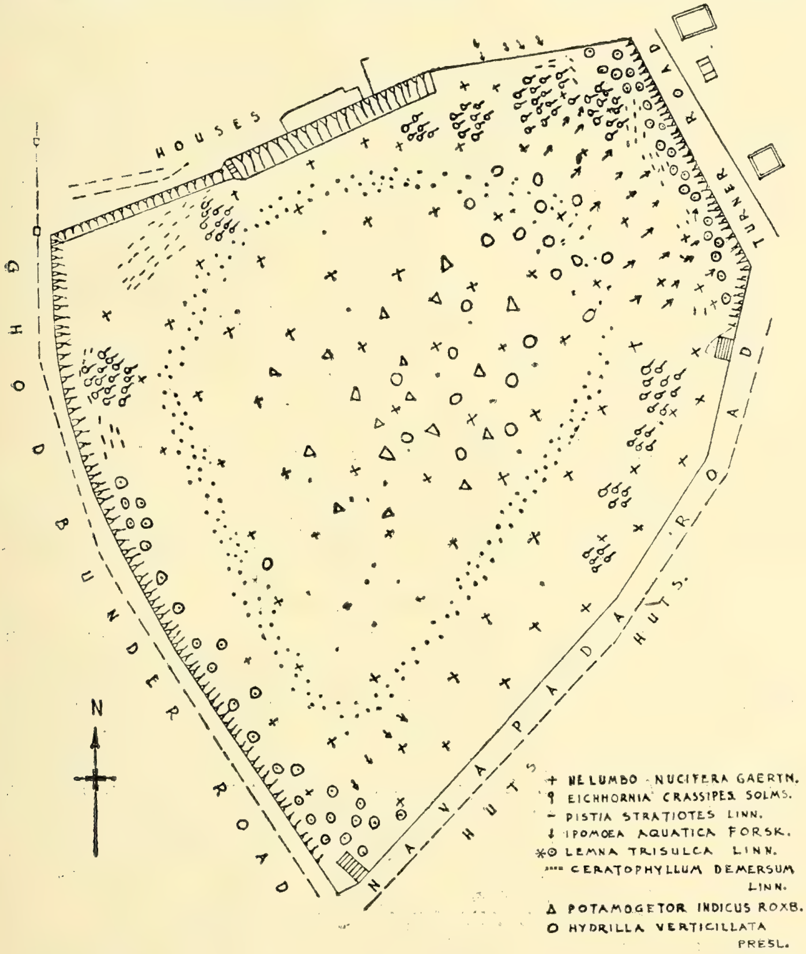
HOUSES
TURNER ROAD
GHOD BUNDER ROAD
NAVAPADA ROAD
HUTS
HUTS
N
+ NELUMBO NUCIFERA GAERTN.
ꝗ EICHHORNIA CRASSIPES SOLMS.
– PISTIA STRATIOTES LINN.
↓ IPOMOEA AQUATICA FORSK.
*⊙ LEMNA TRISULCA LINN.
---- CERATOPHYLLUM DEMERSUM LINN.
Δ POTAMOGETON INDICUS ROXB.
O HYDRILLA VERTICILLATA PRESL.

Fig. 1.—Plan of the Tank at Bandra.

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* The identity of the species of *Lemna* is uncertain.

water of the tank for washing and other purposes. On the northern side is a wall, flanking which are a number of buildings.

The tank is exposed to the full force of the sun and the wind, and hence is more easily affected by variations in meteorological conditions. Its main supply of water is from rain received during the monsoon. During the latter half of the monsoon, it overflows through an outlet into a low level street drain. The average depth of the tank is 12 feet, the maximum level in the monsoon being 15 feet. The depth towards the end of May in the middle is 6 feet.

A study of this tank is of additional interest, as it is used by the Department of Fisheries, Bombay, for stocking and breeding freshwater fish. Pearsall (1924) has laid considerable emphasis on the economic importance of limnological studies, on account of their relation to problems connected with freshwater fisheries.

PHANEROGAMIC VEGETATION OF THE TANK.

In this tank there is a profusion of water weeds. The chief form is *Nelumbo nucifera* Gaertn. (*Nelumbium Speciosum* Willd.) which covers practically the whole surface and is not restricted to any definite region (Photograph 1). Except for *Nelumbo,* the plants are not found scattered indiscriminately all over the tank, but there is some sort of zonation. The first zone consists of *Lemna., Eichhornia crassipes* Solms., *Pistia Stratiotes* Linn. and *Ipomoea aquatica* Fosk. The second zone consists of *Ceratophyllum demersum* Linn., together with which on the eastern side may be mixed *Hydrila verticillata* Presl. The centre of the tank is occupied chiefly by *Potamogeton indicus* Roxb., and a small amount of *Ceratophyllum* and *Hydrilla.* In addition the following plants have occasionally been found, viz. *Limnanthemum indicum* Thw., *L. cristatum* sp. Griseb., *Naias, Wolffia Michelii* Sch.

When the pond dries up in summer (Photograph 2) numerous grasses spring up and shepherds utilize the dry portion as a grazing ground for their flocks.

METHODS.

Collections of the algae were made once a fortnight from along the sides of the tank and from the middle. The frequencies of the various species were noted according to the method of Howland (1931) (*cf.* also Gonzalves and Joshi, 1943). The quantity of the larger algae was estimated from general impression obtained after observation made in the open field. The diatoms were not taken into account in the investigation.

METEOROLOGICAL DATA.

The meteorological data viz. for temperature, sunshine value and rainfall were obtained from the Bombay Observatory. The monthly average temperature was calculated from the maximum and minimum temperatures each day. The monthly average sunshine value was calculated from the values of daily hours of bright sunshine. The rainfall for the month represents the total rainfall received during the month. The meteorological data from December 1940 to November 1941, during which time the tank was under observation, are given in Appendix I. The rainfall for the year was only 34.19 inches, very near the minimum (33·4 inches) recorded during the last 90 years. Consequently in most of the months the maximum temperature exceeded the average. The graphs showing the average temperature, rainfall and hours of bright sunshine are shown in Fig. 2.

CHEMICAL ANALYSIS OF THE WATER.

Every month the water was chemically analysed. In order to calculate the results statistically, eight samples of water from different parts of the tank were each month analysed for (1) dissolved oxygen, (2) free carbon dioxide, (3) total dissolved solids, (4) total hardness, (5) oxdisable organic matter, (6) free ammonia, (7) albuminoid ammonia, (8) nitrites, (9) nitrates, (10) carbonates, (11) bicarbonates, (12) chlorides, (13) phosphates and (14) pH. The results are given in Appendix I and were in all cases found to be statistically significant. The samples were collected as far as possible every time between 11 a.m. and 12 noon.

Dissolved Oxygen.

The dissolved oxygen was estimated by Winkler's method (Public Health Chemical Analysis, pg. 96).

The oxygen content of any piece, of water as mentioned by Ganapati (1940) depends on the composite effect of the following factors:—(1) the solubility of oxygen depending upon the temperature at the time of sample collection, (2) the intensity of illumination, (3) photosynthetic activity of the vegetation, (4) respiratory processes, (5) wind action and (6) abundance of vegetation. Con-

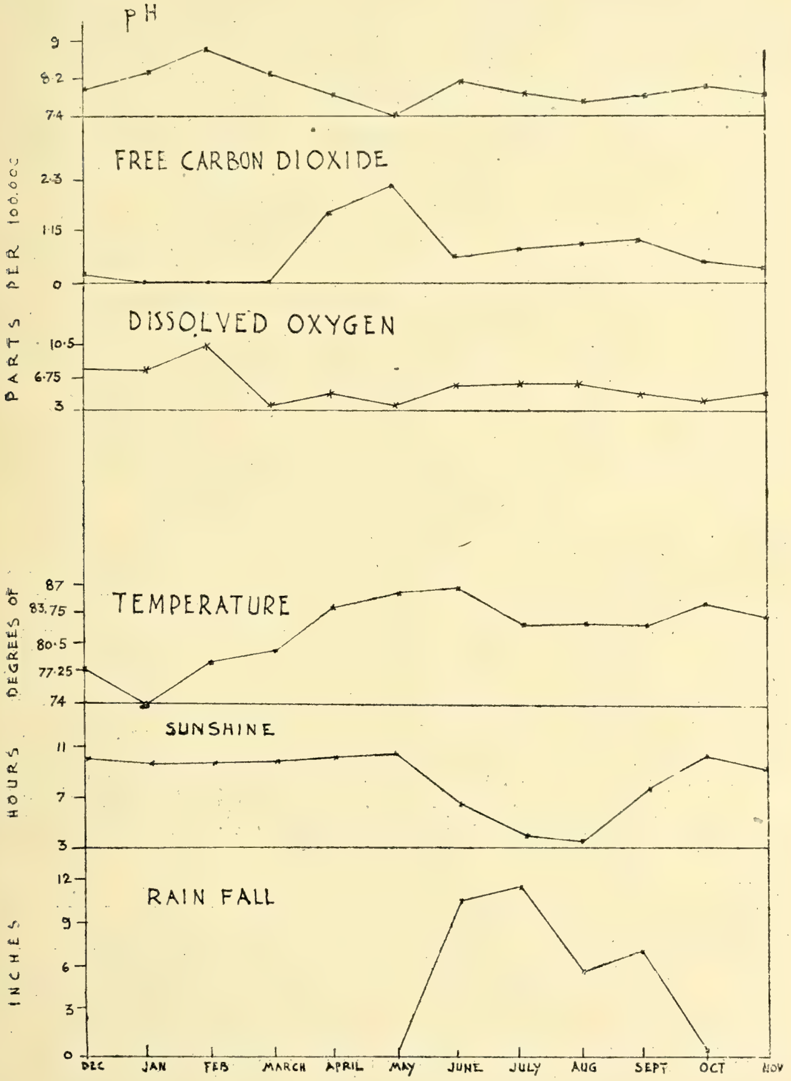

Fig. 2.—Graphs showing meteorological data and variations in the pH, free CO_2 and Dissolved Oxygen of the water of the Tank.

sidering the first factor, it can be seen from the results that periods of high temperature were, except in a few cases, periods of low oxygen content (Fig. 2).

The intensity of illumination had a limited effect on the dissolved oxygen content. During the months of December, January and February, when the sunshine values were high, the amount of dissolved oxygen was also high; but in May and October, though the hours of bright sunshine were very high, there was a fall in the oxygen content, due to causes which will be discussed later.

The algae and phanerogams, both qualitatively and quantitatively were found in very healthy condition in January, February and March. Except for March, the amount of dissolved oxygen in these months was unusually high. This is natural because the greater the amount of vegetation, the greater the asssimilation and the consequent liberation of oxygen. The fall in the oxygen content in the month of March may probably be due to the removal of some of the aquatic plants from the tank. About this time the fish were also in abundance. According to Pearsall (1924), an increase in the amount of fish is normally correlated with an increase in the abundance of plankton organisms and is also dependent on the physico-chemical condition of the water. The fish utilize the oxygen of the pond in respiration, but the abundant vegetation during photosynthesis returns much more oxygen to the water.

In the rains active assimilation cannot take place due to cloudy weather and hence the respiratory activities are more marked. A fall in the oxygen content is therefore natural. This however, was not observed. In all probability there was less demand on the oxygen, since the amount of vegetation was less during the monsoon and the number of fish was also few, a large number of them having been removed from the tank at the end of May Another factor, however, played a more important part at this time. Due to the action of wind, the water was oxygenated by mechanical admixture of air and water particles.

The fall in oxygen content in May was due to the temperature and to the unhealthy condition of the vegetation. At the end of the hot season, there was greater consumption of oxygen to oxidise the disintegrating plants. The dissolved oxygen in the water of this tank is thus influenced by a number of factors, the two most important being temperature and the aquatic vegetation.

2. *Free Carbon Dioxide.*

Free carbon dioxide was estimated volumetrically using phenolpthalein as indicator according to the method given by Thresh, Beale and Suckling (1933), p. 307.

The free carbon dioxide in any water varies somewhat rapidly. In this tank it was completely depleted in January, February and March. After March, owing to the photosynthetic activity of the vegetation, it increased and the maximum was reached in May, due to decay of organic matter. A steady fall followed with only a slight rise in August and September (cf. Appendix I).

There was a slight degree of relationship between the sunshine values and the free carbon dioxide. The free carbon dioxide did not always vary inversely with the oxygen content. A definite relation to the pH and bicarbonates was noticeable. Except for July and November, the free carbon dioxide content was always inversely proportional to the pH (Fig. 2). Howland (1931) and Pearsall (1930) also observed the same relationship.

3. *Total Solids.*

They were estimated according to the method given in Public Health Chemical Analysis, p. 68.

The amount of total solids was low in the cold season, high in the hot season and decreased in the monsoon. The slight fall in February might have been due to the rain received in the preceding month, as also to greater absorption due to increase in numbers and development of the algae and phanerogams. In May, most of the vegetation was decaying and so a rise in the amount of dissolved solids was natural, as the products of decaying matter were returned to the water. The total solids varied in proportion to the temperature (Figs. 2, 3), and nearly always varied inversely to the water level. In June however, there was no immediate fall in the amount of dissolved solids, even though the rainfall was 10.33 inches. Transeau (1916) has shown that high salt concentration does not always coincide with low water level, as the rains bring in soluble salts as well as silt, clay and suspensoids which settle slowly at the bottom of the pond. Hodgetts (1921) also found that the water level and the amount of dissolved salts were not always inversely proportionate.

There was a clear relation between the pH and solids in the first half of the year. When the former was high, the latter was low and vice versa; but in the latter half of the year, the relationship was not so apparent.

4. *Total Hardness.*

Estimations were made according to the soap method (Public Health Chemical Analysis, p. 84). Results are given in degrees of hardness.

According to Thresh, Beale and Suckling (1933, p. 21) the water can be classified as fairly hard. In the cold weather, the values for hardness were fairly low (Fig. 3) due to precipitation of the carbonates by the abundant water plants. A rapid increase occurred in the hot season due to increase in the amount of bicarbonates. Low figures were obtained during the monsoon probably as a result of the rainfall and the consequent dilution of the water. The hardness varied inversely with the water level except on one occasion, *viz.* in February.

5. *Oxidisable Organic Matter.*

Tidy's modification of the Forschammer's process was used in the estimation of organic matter (Public Health Chemical Analysis, p. 93).

The amount of organic matter was moderately low in the beginning of the year; but with the onset of the hot weather and the consequent decay of vegetation, the values increased till the maximum was reached in May. The beginning of the monsoon caused a lowering of the values, till the minimum was reached in August. The amount of oxidisable organic matter rose towards the end of the year (cf. Appendix I and Fig. 3).

6. *Free Ammonia.*

It was estimated by Wanklyn's Process (Public Health Chemical Analysis, p. 77).

In the beginning of the cold season, there was a fall in the amount of free ammonia, till the minimum was reached at the end of the season. A rise in April was followed by a fall in May. During the rains, the values for free ammonia were very high, the maximum being reached in August. This was probably due to washings from the surrounding areas being brought into the water by the rains. After August there was a gradual fall till November (cf. Appendix I and Fig. 3).

7. *Albuminoid Ammonia.*

It was estimated by Wanklyn's process (cf. above).

After December there was a fall in albuminoid ammonia, till the minimum was reached in February and March. Then it increased till a fairly large amount was present in May and June, when masses of vegetation were in the process of decay. During the monsoon, there was a decrease in albuminoid ammonia till August, followed by an increase in the remaining months of the year. On the whole except for February and March, there seemed to be some correlation between albuminoid ammonia and organic matter.

8. *Nitrites.*

They were estimated by Ilsovay's Napthylamine Test (*Journal of the Marine Biological Association,* Vol. 14, p. 56).

Nitrites were only found in traces throughout the year.

9. *Nitrates.*

They were estimated by Frederick's modification of the Phenolsulphonic sulphuric acid method (Public Health Chemical Analysis, p. 81).

From December the nitrates decreased gradually till the minimum was reached in February. Then they rose with the rains, till the maximum was reached in July, after which there was a fall.

When vegetative activity was high, nitrates were depleted by the phanerogams and green algae. At the end of the hot season, the nitrates were fairly high, due to the decaying vegetation. They increased still more during the monsoon, probably due to drainage water charged with nitrates from the surrounding land being washed into the tank by the rains, and to the disturbed condition of the water (Fig. 3). Lind (1938) also found an increase in nitrates after heavy rainfall.

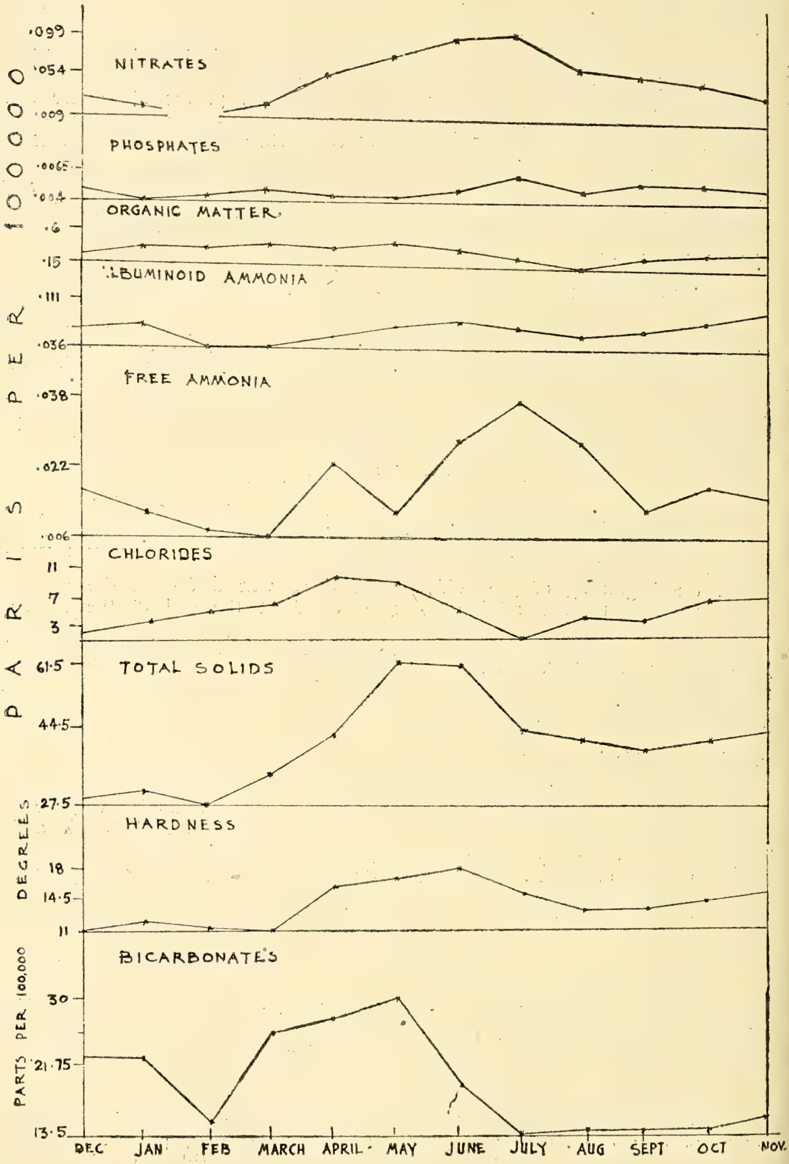

Fig. 3.—Graphs showing variations in the chemical constituents of the water of the tank.

10. *Carbonates.*

They were estimated by the acid-alkalinity method. (Sutton, p. 65).

They were found only for three months when carbon dioxide was absent. According to Ganapati (1941) the period of active photosynthesis is a period of greater formation than destruction of organic matter. In the absence of free carbon dioxide, the green plants utilise the carbon dioxide from the bicarbonates for assimilatory purposes and the result is the precipitation of the less soluble carbonates.

11. *Bicarbonates.*

They were estimated by the acid-alkalinity method. (cf. above).

The bicarbonates were variable in the cold season. The low values in February were probably due to the causes enumerated above. The rise in March may have been due to the removal of some of the green plants and the consequent lowering of the rate of photosynthesis. The large amount of decaying vegetation accounts for the rise at the end of the hot season. After the hot season, there was a steady decrease in the bicarbonates, which remained fairly low and almost constant during the monsoon.

12. *Chlorides.*

They were estimated by the standard $AgNO_3$ method using potassium chromate as an indicator (Public Health Chemical Analysis, p. 70).

The values for chlorides seemed to depend on the water level. When the water level was decreasing and the concentration consequently increasing, the chlorides also increased. In April and May, the amount of chlorides was therefore high, while the water level was very low (Fig. 3). With the rise in water level due to the rains and the consequent dilution of the water, the amount of chlorides diminished.

13. *Phosphates.*

They were estimated colorimetrically by the method given by Atkins (1923) (cf. the Coeruleomolybdic Method of Deniges, *Journal of the Marine Biological Association,* Vol. 13, p. 144).

The values for phosphates were fairly low and more or less constant. Their production was continuous throughout the year by bacterial action, as also by contamination of the tank by human agencies. They are among the important nutrient substances found in pieces of water. The slight fall in phosphates in the cold season was due to utilization by the green vegetation during photosynthesis. Atkins (1923) found that the values for phosphates in ponds were considerably less in the months in which photosynthesis is active. In this tank the fall in phosphates was not so apparent.

14. *pH.*

The pH was determined in the field roughly with Universal Indicator. In the laboratory the pH was again determined using Beckmann's pH meter with the glass electrode.

The pH value was highest in the cold season due principally to the richness of the flora. In the hot season the minimum was reached as a result of stagnation, decay of vegetation and an increase in carbon dioxide. Atkins and Harris (1924) and Pearsall (1930) also observed a seasonal rise and fall in pH. The pH value showed a considerable degree of correlation with temperature, the concentration of dissolved carbonates and bicarbonates, concentration of the nutrient salts, dissolved oxygen, and as mentioned before, with the free carbon dioxide. On several occasions this was clearly brought out, e.g. in February the values for pH, oxygen and carbonates were very high, while the bicarbonates were low and free carbon dioxide absent (Figs. 2 and 3).

A general consideration of the chemical nature of the water showed that all the salts increased with a decrease in the water level. At the close of the hot season, the water level was extremely low, and due to the stagnant conditions, unoxidised organic compounds were present, resulting in high oxygen absorption and an increase in ammonia and carbon dioxide values. The dissolved solids, organic matter, chlorides and bicarbonates also reached their maxima. With the first rains, these decreased slightly and the values for hardness and albuminoid ammonia were very high, but there was not much change in the amount of dissolved solids. As the rainfall increased, there was a

TABLE I

THE FREQUENCIES OF SOME OF THE ALGAL SPECIES IN THE BANDRA TANK

—	Dec.		Jan.		Feb.		March		April		May		June		July		Aug.		Sept.		Oct.		Nov.	
*1. *Pandorina morum.*	...	...	...	...	...	...	...	...	...	...	...	...	rc	va	a	a	rc	i	...	...	...	...	...	...
*2. *Gloeotaenium Loitlesbergerianum*	vc	a	va	vc	c	rc	r	r	c	c	rc	rc	r	r	...	...	r	r	r	r	c	vc	vc	vc
*3. *Oedogonium decipiens* f. *dissimile.*	rc	rc	rc	c	c	vc	†a	a	a	a	c	rc	rc	rc	rc	rc	vc	†c	rc	rc	rc	rc	rc	rc
*4. *Oedogonium iowense* ...	rc	rc	rc	c	vc	vc	†va	a	a	rc	rc	r	r	vc	†vc	c	c	rc	rc	rc	rc	rc	rc	c
5. *Spirogyra formosa.*	rc	rc	rc	rc	c	†c	rc	rc	r	r	...	...	...	r	rc	rc	vc	c	rc	rc	rc	rc	rc	rc
*6. *Cosmarium Quadrum* ...	i	i	rc	rc	rc	c	c	a	va	c	rc	i	i	i	i	i	i	i	i	i	i	i	i	i
7. *Coelosphaerium Kuetzingianum* ...	r	r	rc	rc	rc	c	vc	a	c	a	a	a	c	c	c	rc	rc	rc	rc	rc	r	r	r	r
8. *Aphanocapsa Elachista* var. *conferta* ...	i	i	rc	rc	rc	c	a	a	a	a	a	c	rc	...	...	rc	rc	rc	rc	rc	rc	rc	rc	rc
*9. *Lyngbya Birgei* ...	r	r	r	r	rc	c	va	a	a	a	a	a	a	a	c	c	rc	rc	rc	rc	rc	r	r	r
*10. ,, *sestuarii.*	i	i	r	r	rc	c	a	c	rc	rc	rc	rc	c	c	a	a	rc	c	c	c	c	c	i	i
11. *Anabaena fertilissima* ...	r	r	va	rc	r	r	...	...	...	...	r	r	r	r	r	r	...	...	...	...	...	...	...	...
*12. *Aulosira fertilissima* ...	c	c	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rc	rc	c	c	va	va	a	a

* Represents 'dominant' species. † Represents sectual reproduction.

The numerical values of the symbols are obtained from counts of individuals found in 50 fields of the microscope, under a magnification, of 350 and the meanings are as follows:—

i (isolated) = 1; vr (very rare) = 1–5; r (rare) = 5–10; rc (rather common) = 10–20; c (common) = 20–30; vc (very common) = 50–100; a (abundant) = 100–200 and va (very abundant) 200–400.

consequent decrease in all salts, till a minimum was reached in the middle of the monsoon. As the monsoon abated, a rise in the dissolved solids followed. The amount of total solids in December 1940 was much lower than the amount of solids in November 1941. This was probably due to the wide difference in the amounts of rainfall during the two years. The year 1941 was exceptional, the rainfall being very low, viz. 34.19 inches, whereas in 1940 the rainfall far exceeded the average, amounting to 90 inches.

THE ALGAL FLORA OF THE TANK.

The number of species observed throughout the year was 103. Table I shows the frequencies of some of the more common forms. Some of the species are seen throughout the year and can be regarded as *perennials* even though they may not be in abundance at any time. These, according to Pearsall (1924) are the *constant* forms as they are found in all or in over 75% of the collections. A large majority of the remaining forms are seen for a brief spell, either as stray or common forms. Such species are regarded as *ephemerals.* A third group of algae are seen for a longer period than the ephemerals but not throughout the year. For the purpose of discrimination they are called the *intermediate* species. If any of the species in these groups at any time constitutes 30% of the algal vegetation, it can be called the *dominant* species of the period. The list of the algae is given in Appendix II. The letters after the name of the alga denote whether it is constant (c), intermediate (i) or ephemeral (e).

SUCCESSION OF THE ALGAL FLORA.

The algae are very plastic forms and can adapt themselves to numerous alterations in their environment. Changes in the weather and water conditions however, do affect them to a certain extent, so that some forms are only seen when conditions are favourabe to their growth. In this tank a definite succession of the algal flora was observed from season to season.

THE ALGAE OF THE COLD SEASON.

The investigation commenced in December at the beginning of the cold season. This season (Dec-mid-March) is characterised by low temperature, fairly long hours of bright sunshine and little or no rain. The daily range of temperature is largest during this time and may be over 11°.

In December all the algal classes were represented by a few forms belonging to each, except the *Heterokontae,* which occurred later. As the season advanced, numerous species appeared, the majority in small numbers; but a good percentage thrived satisfactorily, increased in quantity and then declined. Many of them were restricted to the cold season only. Some of them became abundant in the early part or the middle of the cold season. Others took longer to develop, and reached their maxima towards the end of the cold season.

The majority of the green filamentous forms such as *Zygnema, Spirogyra, Bulbochaete* and *Oedogonium* thrived best at this time and reproduced themselves, some at the commencement, others at the end of the season. The period was also most favourable for the growth of members of the *Desmidiaceae* and *Chlorococcales.* Of the *Myxophyceae,* only *Anabaena fertilissima* was found in abundance in the early part of January.

THE ALGAE OF THE HOT SEASON.

The hot season (mid-March-May) is characterised by long hours of bright sunshine, high temperature and no rainfall. The day to day variation in temperature is smallest during this season, particularly in April and May, when the temperature is very high and the humidity is high. *Oedogonium* continued forming oospores and remained fairly well represented during the early part of the hot season.

A gradual change occurred in the algal flora from the middle of March onwards. Most of the desmids disappeared and only a few persisted as stray specimens. Except for *Scenedesmus,* which was seen in May, the green algae were in the minority in the latter half of the hot season while members of the *Myxophyceae* were prominent. Numerous *Euglenineae* also appeared in small numbers. Towards the close of the hot season, the rest of the vegetation was in an unhealthy condition and masses of them commenced to decay. Except for a small portion in the middle, the tank was dry (Photograph 2). Some of the fish were removed at this time, as the unhealthy conditions affected them adversely.

Thus the only forms that flourished during this period were members of the *Euglenineae* and the *Myxophyceae*. The dominant form of the first half of the season was *Oedogonium* and of the latter part of the season were *Lyngbya Birgei* and *Coelosphaerium Kuetzingianum*.

THE ALGAE OF THE MONSOON.

The rains in Bombay occur from June to September. The monsoon as a rule is usually accompanied by squally winds and afternoon thunderstorms. Once it has well set in, thunderstorms are rare; but they may occur again towards the end of the season. The arrival of the monsoon causes a welcome fall of temperature and sunshine values also drop. In 1941 the monsoon behaved very erratically, and the total rainfall was only 34.19 inches, well below normal. The temperature also was above the average.

During the period of heavy rain, the tank seemed more or less devoid of algae; but as soon as there was a spell of bright sunshine in the latter half of June, there was a sudden swarming of *Pandorina morum* in the tank, causing a bloom to the exclusion of almost all the other algae. This was the outstanding feature of the monsoon period. Another noteworthy event was the occurrence of a second sexual phase in two species of *Oedogonium*. The least number of algal species occurred during the wet season. This was to be expected as the unsettled and disturbed condition of the water, due to the action of rain and wind, naturally retarded algal development. The algae are delicately constituted, and sudden changes in the concentration of dissolved matter will affect them immediately. Moreover as it was very cloudy, the sunshine necessary for photosynthesis and growth was not available. The dominant form in the early half of the monsoon was *Pandorina morum*, in the latter half, the two species of *Oedogonium*.

THE ALGAL FLORA IN OCTOBER AND NOVEMBER.

After the withdrawal of the monsoon, there is again a rise in the mean temperature in the first half of October, which remains constant till November. This is again another period of minimum variability of temperature, the meteorological conditions at this time being the same as in May. In 1941 there was no rain at all in October and November.

As the hours of bright sunshine increased, new species made their appearance, particularly in November, but the increase in number was gradual. Two members of the *Chlorococcales* viz. *Selenastrum gracile* and *Gloeotaenium Loitlesbergerianum* and a few members of the *Myxophyceae* such as *Anabaena Fullebornii* and *Aulosira fertilissima* etc. were characteristic of the period. The presence of a number of forms belonging to the *Myxophyceae* was not unexpected, as the meteorological conditions in October and May are almost similar, and therefore certain resemblances in the algal flora during the two months, are likely.

DETAILED CONSIDERATION OF SOME OF THE SPECIES.

It is a well-known fact that maintenance of chemical and physical conditions is necessary to allow normal algal growth. It is, however, rather difficult to single out a factor or a group of factors and to attribute to them the presence or absence of a particular species, and therefore no general deductions will be made in this section, but only the local conditions of weather and water favourable for the growth of the more important genera will be discussed.

ISOKONTAE (CHLOROPHYCEAE).

VOLVOCALES.

Gloeocystis.—It was seen in December, became abundant in April and disappeared entirely (Fig. 4) with the first rains. The chief factors influencing its increase in numbers, seemed to be the meteorological conditions, as it was found when the temperature was fairly high, the hours of sunshine very

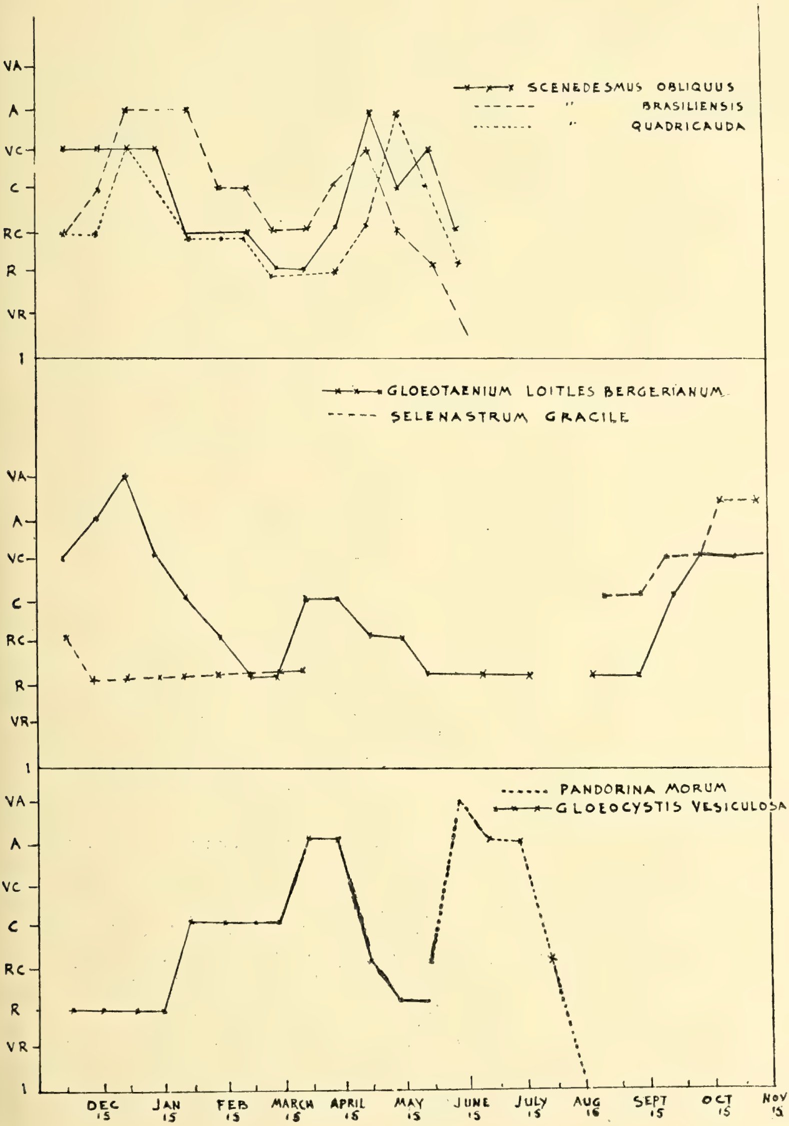

Fig. 4.—Frequency-graphs of some of the algae in the Bandra Tank

high and when there was no rain. It disappeared when the temperature and the sunshine values were lowered, and when the rainfall was plentiful.

Pandorina—It appeared with startling suddenness in the monsoon after the first few showers, and developed so rapidly (cf. Fig. 4), that within less than a fortnight the tank was teeming with it, and the water took on a greenish hue. Asexual reproduction occurred almost immediately after maximum development.

The causes underlying such sudden swarming of plankton are difficult to determine, but Akehurst (1931) found that swarming may be due to the availibility of accessory foods. Other workers have found that the Volvocales are erratic in occurrence, and are markedly influenced by sudden changes in the weather. According to Howland (1931) *Pandorina morum* was very common in a month when the rainfall was abnormally high, sunshine record low, and the salt concentration not unusually high; while Fritsch and Rich (1913) found that abundant sunshine and high salt concentration were detrimental to its growth. Hodgetts (1922) however found pronounced growth of *Pandorina* coinciding with rising concentration. Here *Pandorina* occurred after sudden and much rain and when there was less of sunshine and decreasing concentration.

CHLOROCOCCALES

Gloeotaenium—Except for the month of July, when the rainfall was very high, this genus was seen throughout the year, though not in abundance. It commenced to increase from October and in January it reached its maximum after which there was a fall in its numbers (Fig. 4). The conditions favourable for its development were very low temperature, fairly long hours of sunshine, low concentration of dissolved solids, large amount of dissolved oxygen and not much carbon dioxide and nitrates.

Scenedesmus—All the three species of *Scenedesmus,* though not equally abundant, had two maxima. The first was in the cold season (Dec.-Jan.). A sudden increase occurred in May, followed by rapid disappearance (Fig. 4). The periodicity of *Scenedesmus* was rather puzzling, as the physical and chemical conditions of the water on the two occasions when it was in abundance, were totally different. The only similar factors were absence of rain, long hours of sunshine and the same amount of free and saline ammonia. On the whole it is dangerous to attribute the presence or absence of *Scenedesmus* to any particular factor, as it seems to be one of those ubiquitous forms which is rarely absent from any piece of water, and is seen almost throughout the year.

Selenastrum—It was found in December 1940 as a rather common form, but presumably it was declining, as in January 1941 it was rare. It disappeared in March. In September it reappeared, and by November it was abundant (Fig. 4). It is therefore a species which developed rapidly in the post-monsoon period with the advent of more settled conditions and longer hours of sunshine.

Pediastrum—*Pediastrum tetras* was a *constant* form which was rare throughout the year, but became abundant in early February. The cold season was therefore favourable for its development. The other two species of *Pediastrum* occurred in the monsoon during a spell of bright sunshine after days of heavy rain. They disappeared as soon as another period of excessive rain set in.

A consideration of this order brings out some interesting facts. Some of its members may occur in the monsoon, but they disappear very soon, and cannot develop to any considerable extent. Most of them attain their greatest development in December or January during the early part of the cold season. It seems as if the low temperature of this period, together with the large amount of dissolved oxygen and high pH, support their growth. Griffiths (1923) found them in places where the oxygen content of the water is relatively high. Howland (1931) found them when pH, water level and salt concentration are moderately high. Both their results are confirmed here.

CHAETOPHORALES

Aphanochaete repens—It was observed as an epiphyte on *Oedogonium.* It showed a certain amount of relation to the periodicity of its host; but unlike *Oedogonium,* it was not seen throughout the year.

Coleochaete scutata—It was epiphytic on the leaves of *Potamogeton* in early February. It developed best in late March, and disappeared by April. Howland (1931) found that it favoured high pH. Here too the pH was high when it thrived.

The *Chaetophorales* developed towards the end of the cold season and the beginning of the hot season, and the conditions necessary for their growth seemed to be the same as those for their hosts.

OEDOGONIALES.

Oedogonium—Five species of *Oedogonium* were recorded from the tank, but only two of them were *constant*. All of them began to reproduce sexually in March and April. In May they appeared to be in a definitely unhealthy condition. With the rains however, they seemed to revive and the two constant species formed oogonia again. Both these species had two reproductive phases (Fig. 5). Strφm (1924) remarks that two conjugation maxima annually are ing a period of great vegetative activity in a spell of bright weather after

A belief held by the early algologists was that the lower forms enter into the reproductive stage at the end of their vegetative activity. It has however been found that phases of reproduction may coincide with periods of greatest vegetative activity. In this tank the first reproductive phase of *Oedogonium* occurred at the end of vegetative activity, when the sunshine was abundant, the pH fairly high, the concentration of water and carbon dioxide increasing and oxygen content decreasing. The second reproductive phase occurred during a period of great vegetative activity in a spell of bright weather after excessive rain. Brown (1908) has shown that a sudden change in external conditions can check the growth of an alga and cause it to fruit sexually. The sudden change in the environmental conditions probably influenced the second reproductive phase.

Bulbochaete—It was seen in December and reached its maximum in January (Fig. 5). The conditions which favoured its growth and development seemed to be the same as those for the Chlorococcales.

CONJUGATAE (ZYGNEMACEAE).

Zygnema—It occurred in December and became very abundant by January. The curves of *Bulbochaete* and *Zygnema* were almost similar (Fig. 5) and the same conditions seemed favourable to both. Hodgetts (1921) found that there was no relationship between *Zygnema* and bright sunshine unless abundant bright sunshines was harmful to it. In this tank *Zygnema* appeared when the hours of bright sunshine were moderately high, and disappeared when they became longer, but temperature seemed to be a more important factor influencing its appearance.

Spirogyra—Two species of *Spirogyra*, one fertile, the other sterile, were common in February. *Spirogyra formosa* formed zygospores in late February or early March, after which it disappeared. It was also seen in the monsoon.

The conditions necessary for the development of *Spirogyra* were almost the same as for *Oedogonium*. Other workers have seen that each time *Spirogyra* became abundant, *Oedogonium* followed suit, and both may even fruit simultaneously. Here also the same relation between the two genera was noticeable.

A few sterile filaments of *Mougeotia* were seen intermixed with *Spirogyra*.

DESMIDIACEAE.

Desmids.—Though the desmids were best represented qualitatively, very few of them were abundant at any time. Only a few occurred in noticeable numbers. Strφm (1924) found that two factors are hostile for the occurrence of desmids in large quantities as plankton organisms—contamination and the basic reaction of the water, viz. pH conspicuously greater than 7. Slight contamination does not affect them much, but serious contamination renders desmid growth impossible.

As the desmids occurred in relatively few numbers, it is impossible to put forward any views with regard to the factors influencing their growth. Most of them were characteristic of the cold season and occurred when the pH and the amount of dissolved oxygen were very high, free carbon dioxide absent, nitrates and albuminoid ammonia very low, oxidizable organic matter fairly low and the water dilute. The meteorological conditions favourable for their growth were no rainfall, fairly long hours of sunshine and low temperature.

HETEROKONTAE.

The only member of this group was *Botryococcus Braunii* which also seemed to prefer the cold season.

EUGLENINEAE.

Euglena—A number of species of *Euglena* were present in the tank. With the exception of *Euglena acus* which was seen in the monsoon, all of them seemed to thrive in the hot season when there was a large amount of organic matter present. Fritsch and Rich (1913) also found that the maximum of *Euglena viridis* coincided with an enrichment of the water with organic matter and Lind (1938) found *Euglena* abundant when albuminoid ammonia was maximum.

Trachelomonas—All the species of *Trachelomonas* occurred in the hot season, and disappeared in July. Howland (1931) did not find *Trachelomonas volvocina* and *T. hispida* when organic contamination was greatest and saw no evident relation between their presence and salt concentration. Hodgetts (1922) however, found that abundant sunshine together with a high salt concentration was favourable to them. In this case they were present when there was abundant sunshine, large amount of organic matter and in very concentrated water.

The flagellates therefore seemed to favour high tempearture, great light intensity and no rain. They appeared when there was a large amount of decaying vegetation and consequently much organic matter in the tank. They were not wiped out entirely by heavy rain, but persisted for some time.

MYXOPHYCEAE.

Lyngbya—Two species of Lyngbya usually occurred together in the tank. The curve for the first viz. *Lyngbya aestuarii* was almost similar to that for *Oedogonium iowense* (Fig. 5). It was thus influenced by the same factors as *Oedogonium* except that it was more unsuited to the cold season. Moreover it was unable to thrive in the latter part of the monsoon and soon disappeared.

Lyngbya Birgei was the second species. It was very abundant in March and remained so till July (Fig. 5). It decreased in numbers during the latter part of the monsoon. It was typical of the hot season, and favoured the same conditions as the flagellates.

Oscillatoria—Four species of *Oscillatoria* were seen in the tank. All of them, with the exception of *Oscillatoria gloeophila* which was found in the hot season, were found in the monsoon when the water was fairly dilute. They were however never seen in abundance.

Anabaena. Two, out of the three species of Anabaena, were fertile. *A. Fullebornii* occurred in September and formed spores in October. It persisted till March. *A. Fertilissima* was seen during the monsoon as a rare species, but it became abundant in January. Whenever it was seen, it was forming spores. Thus it was probably a type which did not remain long in the vegetative condition, but formed spores at once.

Aulosira. Filaments of *Aulosira fertilissima* occurred densely intertwined forming mats which seemed like decaying leaves. By September and October the species was very abundant and had formed spores, every alternate cell of the filament being transformed into a spore.

Coelosphaerium. It was seen throughout the year, but was abundant from the end of March till the end of May. It persisted during the monsoon as a rather common form but became rare in October (Fig. 5). The other genera were only seen in the hot season.

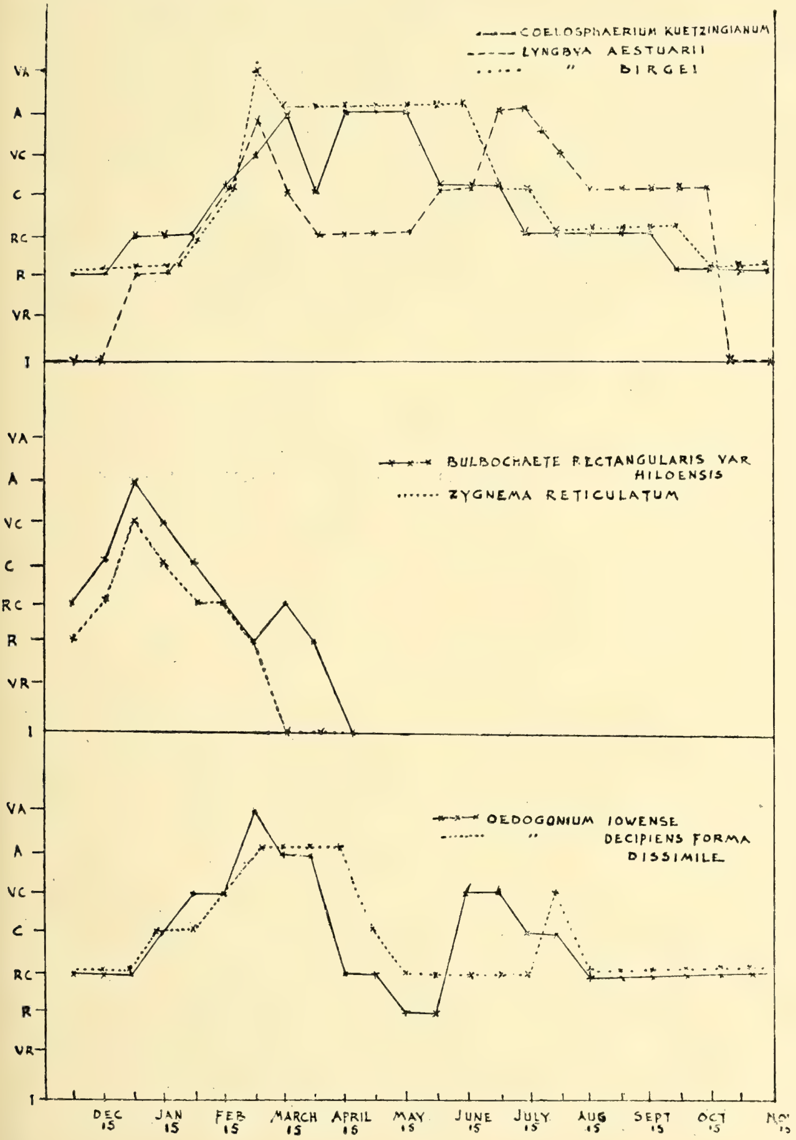

Fig. 5.—Freequency-graphs of some of the algae in the Bandra Tank

A consideration of the Myxophyceae brings out the fact that most of them like the flagellates, occur in May. High temperature seems to be the deciding factor for their good development. This is also shown by the fact that some of the Myxophyceae like *Aulosira*, *Gloeotrichia* etc. develop in October when the temperature and temperature variations are the same as in May. Thus most of the Myxophyceae favour high temperature; but some of them can only thrive when there is a considerable amount of organic matter present in the water and when the concentration of dissolved salts is fairly high. Other species can thrive in more dilute waters. Only a few forms like *Calothrix marchica* var. *crassa* and *Anabaena fertilissima* are seen in the cold season.

SUMMARY.

1. This paper deals with the seasonal succession of the algae in a tank at Bandra and the relation of the algal flora to the chemical constitution of the water and the meteorological conditions.

2. The algae were collected at fortnightly intervals for a year, and the water was analysed once a month.

3. The water level at the close of the hot season was very low and there was an increase in all the salts. The first rains did not make much difference in the amount of dissolved solids; but later, as the water level increased, there was a decrease in all salts till a minimum was reached in the middle of the monsoon. As the monsoon abated, there was a rise in the dissolved solids.

4. The number of algal species observed in the tank was 103. Of these, 8 were *constant*, 42 *intermediate* and the rest were *ephemerals*.

5. The majority of the species were seen in the cold season, which was characterised by the predominance of members of the Chlorophyceae. They grew luxuriantly and many species reproduced themselves. In the hot season, members of the Myxophyceae and Englenineae thrived. The least number of species was seen in the monsoon. During the October-November period, there were more species than in the rainy season, and the period was also characterised by the appearance of a number of members belonging to the Myxophyceae.

6. By noting the condition of the weather and water when some of the more important species appeared, the local conditions favourable for their growth are determined.

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APPENDIX I.

Month.	pH	Dissolved Oxygen.	Free Co2.	Total Solids.	Total Hardness.	Organic matter	Free Ammonia.	Albuminoid Ammonia.	Nitrates.	PO_4.	Cl.	Bicarbonate.	Carbonates.	Temperature.	Sunshine.	Rainfall.
1940— December ...	8·02	7·58	·22	28·57	11	·371	·0166	·071	·023	·00495	5	21·65	...	77·45	10	Nil
1941— January	8·36	7·76	Nil	30·2	12	·441	·0124	·086	·018	·00416	5·56	22	1·4	73 86	9·7	0·07
February ...	8·95	10·003	Nil	27·4	11	·421	·007	·036	·009	·00436	6·52	14·58	2·8	77·9	9·7	Nil
March	8·37	3·19	Nil	34·2	11	·522	·006	·037	·017	·0054	7·14	25·86	0·4	79·03	9·7	,,
April	7·88	4·53	1·7	43·8	16	·511	·024	·057	·047	·0045	10·76	27·87	...	84·77	9·8	,,
May	7·41	3·12	2·3	61·42	17	·612	·012	·087	·064	·0046	10·27	30·05	...	86·37	10·7	,,
June	8·17	5·54	·7	60·5	18	·585	·028	·097	·084	·0054	6·68	19 66	...	86·68	6·9	10·33
July	7·95	5·69	·5	45·2	15	·371	·038	·089	·091	·0065	2·08	13·6	...	82·43	3·9	11·79
August	7·67	5·55	·91	42·38	13	·142	·028	·061	·072	·0051	3·56	14·25	...	84·84	3·1	5·83
September ...	7·8	4·7	·93	40·25	13	·281	·012	·068	·052	·006	5·32	14·24	...	82·43	7·2	6·17
October	8·12	4·03	·4	43·12	14	·42	·017	·101	·044	·0062	7·85	14·9	...	84·94	9·7	Nil
November ...	7·81	4·9	·3	44·25	15	·481	·015	·111	·032	·0055	8·12	15·575	...	83·76	9·5	,,

APPENDIX—II.

THE ALGAL FLORA OF THE TANK.*

ISOYONTAE : (CHLOROPHYCEAE).

VOLVOCALES.

1. *Gloeocystis vesiculosa* Nāg. (i).
2. *Pandorina morum* (Mull.) Bory (e), (d).

CHLOROCOCCALES.

3. *Pediastrum tetras* (Ehr.) Ralfs., (i).
4. *Pediastrum duplex* Meyen var. *genuinum* A. Br. (e).
5. *Pediastrum clathratum* (Sch.) Lemm. (e).
6. *Sorastrum spinulosa* Nag. (e).
7. *Trochiscia obtusa* (Reinsch) Hansg. (e).
8. *Oocystis solitaria* Wittr. (i).
9. *Oocystis elliptica* W. West. (i).
10. *Oocystis lacustris* Chodat. (e).
11. *Gloeotaenium Loitlesbergerianum* Hansg. (c), (d).
12. *Tetraedron muticum* (A. Br.) Hansg. forma *minimum* Reinsch. (e).
13. *Tetraedron trilobatum* (Reinsch) Hansg. (e).
14. *Tetraedron trigonum* (Nāg) Hansg. forma *gracile* Reinsch. (e).
15. *Ankistrodesmus falcatus* (Corda) Ralfs. (e).
16. *Ankistrodesmus spirlais* (Turner) Lemm. (e).
17. *Selenastrum gracile* Reinsch. (i).
18. *Kirchneriella lunaris* (Kirchner) Mob. (e).
19. *Westella botryoides* (W. West) Schmidle. (e).
20. *Dimorphococcus lunatus* A. Br. (e).
21. *Scenedesmus obliquus* (Turpin) Kütb. (i).
22. *Scenedesmus brasiliensis* Bohlin. (i).
23. *Scenedesmus quadricauda* (Turpin) Bréb. (i).
24. *Coelastrum cambricum* Archer. (i).

CHAETOPHORALES.

25. *Aphanochaete repens* A. Br. (i).
26. *Coleochaete scutata* Bréb. (e).

OEDOGONALES.

27. *Oedogonium varians* Wittr. (e).
28. *Oedogonium decipiens* Wittr. forma *dissimile* Hirn. (c), (d).
29. *Oedogonium iowense* Tiffany. (c), (d).
30. *Oedogonium longicolle* Nordst. (e).
31. *Oedogonium inconspicuum* Hirn. (e).
32. *Bulbochaete rectangularis* Wittr. var. *hiloensis* Nordst. (i).

CONJUGATAE.

33. *Zygnema reticulatum* Hallas. (i).
34. *Spirogyra formosa* (Transeau) Czurda. (c).
35. *Spirogyra sp.* (e).
36. *Mougeotia sp.* (i).
37. *Closterium Venus* Kütz. (i).
38. *Closterium Acerosum* (Schr.) Ehr. (e).
39. *Closterium Leibleinii* Kütz. (i).
40. *Closterium Dianae* Ehr. (e).

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* The classification followed is that of West and Fritsch as given in 'A Treatise on the British Freshwater Algae'. 1927. 'c' denotes '*constant*', 'i' denotes *intermediate*', 'e' denotes '*ephimeral*' and 'd' denotes '*dominant*' species.

41. *Closterium sp.* (new). (e).
42. *Closterium sp.* (new). (e).
43. *Closterium eboracense* Turn. (e).
44. *Euastrum substellatum* Nordst. (i).
45. *Euastrum bidentatum* Näg. (e).
46. *Micrasterias pinnatifida* (Kūtz) Ralfs. (e).
47. *Cosmarium Lundellii* Delp. var. *ellipticum* West. (i).
48. *Cosmarium Portianum* Arch. (i)
49. *Cosmarium Quadrum* Lund. (i), (d).
50. *Cosmarium Sublatere-undatum* West & West. (i).
51. *Cosmarium Meneghinii* Bréb. (i).
52. *Cosmarium abruptum* Lund. (i).
53. *Cosmarium asphaerosporum* Nordst. (i).
54. *Cosmarium divergens* Krieger (new var.). (i).
55. *Cosmarium sexnotatum* Gutw., var. *tristriatum* (Lutkem Schmidle.) (i).
56. *Cosmarium Phaseolus* Bréb. var. *elevatum* Nord. (i).
57. *Cosmarium cucumis* (Corda) Ralfs. var. *magnum* Racib. (i).
58. *Cosmarium angulatum* (Perty) Rabent. forma *major* Grunow. (i).
59. *Cosmarium contractum* Kirch. var. *ellipsoideum* (Elfv.) West & West. (i).
60. *Cosmarium cymatopleurum* Nord. (i).
61. *Cosmarium subimpressulum* Borge. (e).
62. *Cosmarium granatum* Bréh. (i).
63. *Arthrodesmus convergens* Ehr. (e).
64. *Staurastrum alternans* Bréb. (i).
65. *Staurastrum crenulatum* (Näg.) Delp. (e).
66. *Staurastrum gracile* Ralfs. (i).
67. *Sphaerozosma granulatum* Roy and Biss. (e).

HETEROKONTAE.

HETEROCAPSINEAE.

68. *Botryococcus Braunii* Kūtz. (i).

EUGLENINBAE.

EUGLENACEAE.

69. *Euglena Ehrenbergii* Klebs. (i).
70. *Euglena acus* Ehr. (i).
71. *Euglena deses* Ehr. (e).
72. *Euglena proxima* Ehr. (i).
73. *Euglena oxyuris* Schmarda. (e).
74. *Lepocinclis ovum* (Ehr) Lemm. (e).
75. *Lepocinclis Butschli* Lemm. (e).
76. *Lepocinclis Butschli* Lemm var. *angustata* Deflandre. (e).
77. *Phacus orbicularis* Hub. (i).
78. *Trachelomonas horrida* Palmer var. *crenulatocollis* Skuor. (e).
79. *Trachelomonas armata* Ehr. var. *Steinii* Lemm. (e).
80. *Trachelomonas similis* Stokes. (e).
81. *Trachelomonas volvocina* Ehr. (e).

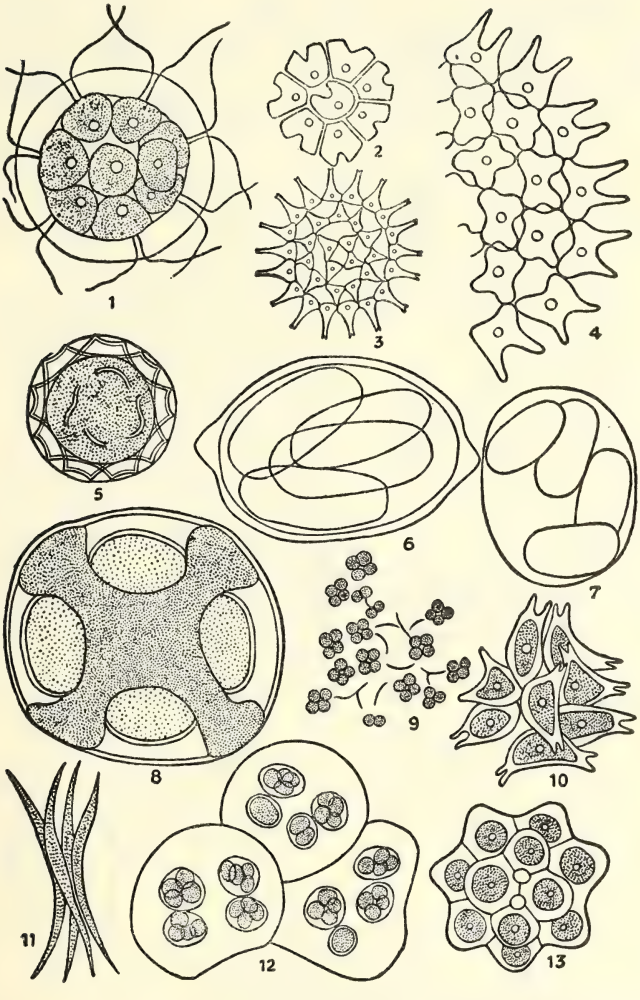
MYXOPHYCEAE (CYANOPHYCEAE).

CHROOCOCCALES.

82. *Aphanothece pallida* (Kūtz.) Rabh. (i).
83. *Coelosphaerium Kuetzingianum* Näg. (c), (d).
84. *Microcystis stagnalis* Lemm. (i).
85. *Microcystis flos-aquae* (Wittr.) Kirchn. (e)
86. *Aphanocapsa elachista* W & G.S. West var. *Conferta* W & G.S. West. (c).
87. *Chroococcus turgidus* (Kūtz.) Näg. (i).

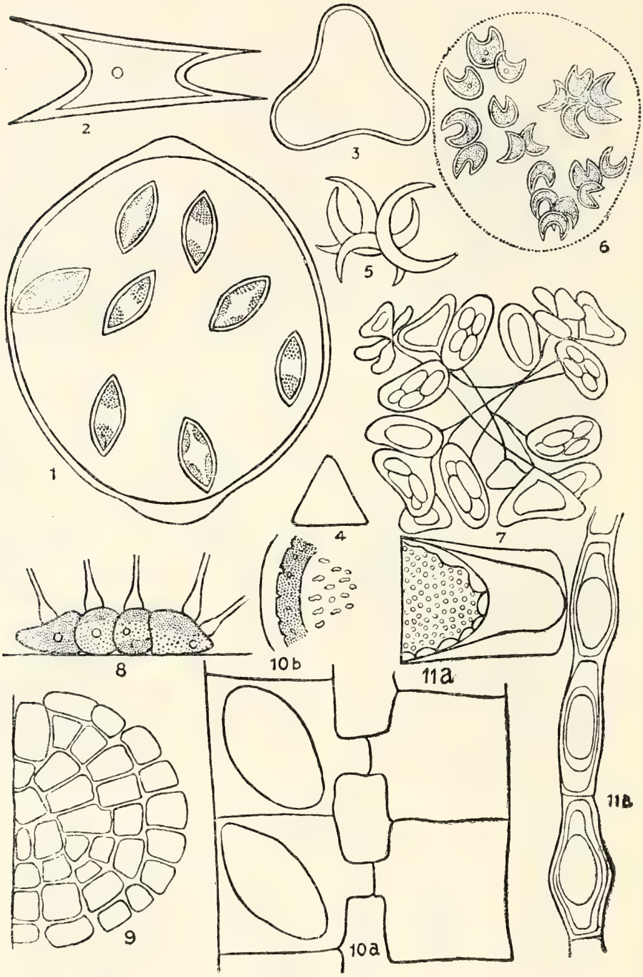
HORMOGONEALES.

88. *Oscillatoria gloeophila* Grun. (c).
89. *Oscillatoria sancta* Kūtz. (e).
90. *Oscillatoria chalybea* Mert. (e).
91. *Oscillatoria tenuis* Ag. (e).
92. *Spirulina subtilissima* Kutz. (e).
93. *Spirulina Major* Kūtz. (e).
94. *Lyngbya aestuarii* (Mert.) Lie. (e).
95. *Lyngbya Birgei* Smith. (c).
96. *Schizothrix lacustris* A. Br. (e).
97. *Anabaena fertilissima* Rao. (e).
98. *Anabaena Fūllebornii* Schmidle. (e).
99. *Anabaena* sp. (e).
100. *Aulosira fertilissima* Ghose. (e).
101. *Tolypothrix distorta* (Fl. D.) Wartm. (e).
102. *Calothrix marchica* LemG. var. *crassa* Rao. (e).
103. *Gloeotrichia Raciborskii* Wolos. (e)



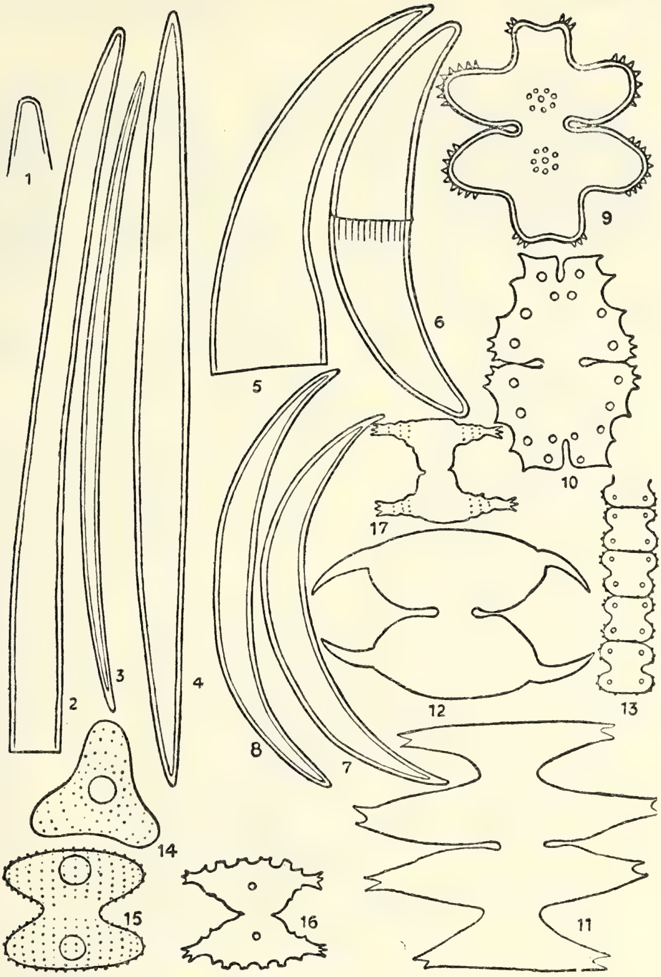
BOMBAY ALGAE.

Fig. 1.—*Pandorina morum* (Muller) Bory. (×406).
Fig. 2.—*Pediastrum tetras* (Ehr.) Ralfs. (×406).
Fig. 3.—*Pediastrum clathratrum* (Schroeter) Lemm. (×262).
Fig. 4.—*Pediastrum duplex* Meyen var. *genuinum* A. Br. (×406).
Fig. 5.—*Trochiscia obtusa* (Reinsch) Hansg. (×406).
Fig. 6.—*Oocystis solitaria* Wittr. (×406).
Fig. 7.—*Oocystis elliptica* W. West. (×406).
Fig. 8.—*Gloeotaenium Loitlesbergerianum* Hansg. (×406).
Fig. 9.—*Westella botryoides* (W. West) de Wildom. (×406).
Fig. 10.—*Sorastrum spinulosa* Näg. (×406).
Fig. 11.—*Ankistrodesmus falcatus* (Corda) Ralfs. (×406).
Fig. 12.—*Gloeocystis vesiculosa* Näg. (×262).
Fig. 13.—*Coelastrum cambricum* Archer. (×182).



BOMBAY ALGAE.

Fig. 1.—*Oocystis lacustris* Chodat. (×406).
Fig. 2.—*Tetraedron trigonum* (Näg) Hansg. forma *gracile* Reinsch. (×406).
Fig. 3.—*Tetraedron trilobatum* (Reinsch) Hansg. (×406).
Fig. 4.—*Tetraedron muticum* (A. Br.) Hansg. forma *minimum* Reinsch. (×406).
Fig. 5.—*Selenastrum gracile* Reinsch. (×406).
Fig. 6.—*Kirchneriella lunaris* (Kirchner.) Moebius. (×406).
Fig. 7.—*Dimorphococcus lunatus* A. Br. (×406).
Fig. 8.—*Aphanochaete repens* A. Br. (×406).
Fig. 9.—*Coleochaete scutata* bréb. (×262).
Fig. 10a—*Spirogyra formosa* (Transeau) Czurda. (×262). (portion of conjugating filament).
Fig. 10b.—Surface view of the mesospore of No. 10a. (×406).
Fig. 11a.—*Zygnema reticulatum* Hallas (showing parthenospores). (×182).
Fig. 11b.—Surface view of the mesospore of No. 11a. (×406).



BOMBAY ALGAE.

Fig. 1.—**Closterium sp.* (new species) Extremity of the cell. (×262).
Fig. 2.—*Closterium sp.* (new species) Semicell. (×52).
Fig. 3.—*Closterium sp.* (new species). (×24).
Fig. 4.—*Closterium acerosum* (Schr.) Ehr. var. *elongatum* Breb. (×40)
Fig. 5.—*Closterium Leibleini* Kütz. (×406).
Fig. 6.—*Closterium sp.* (new species). (×182).
Fig. 7.—*Closterium Venus* Kütz. (×406).
Fig. 8.—*Closterium Dianae* Ehr. (×406).
Fig. 9.—*Euastrum substellatum* Nordst. (×406).
Fig. 10.—*Euastrum bidentatum* Näg. (×406).
Fig. 11.—*Micrasterias pinnatifida* (Kütz.) Ralfs. (×406).
Fig. 12.—*Arthrodesmus convergens* Ehr. (×406).
Fig. 13.—*Sphaerozosma granulatum* Roy and Biss. (×406).
Fig. 14.—*Staurastrum alternans* Bréb. (×406).
Fig. 15.—*Staurastrum alternans* (vertical view). (×406).
Fig. 16.—*Staurastrum crenulatum* (Näg.) Delp. (×406).
Fig. 17.—*Staurastrum gracile* Ralfs. var. *nanum* Wille. (×406).

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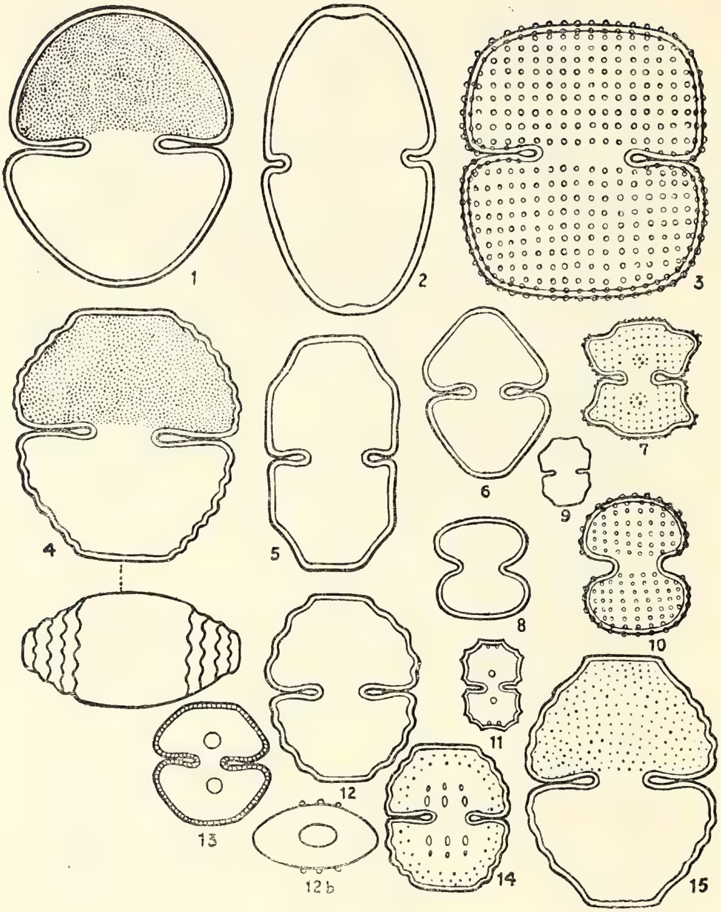
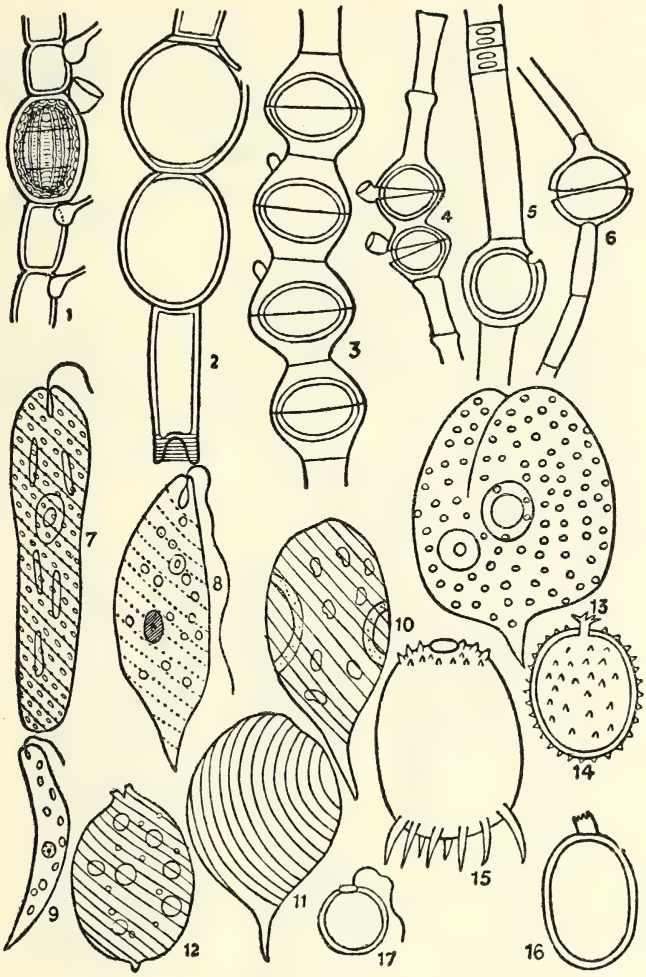
* This sp. appears to be a new species of *Closterium* and will be described in another paper.



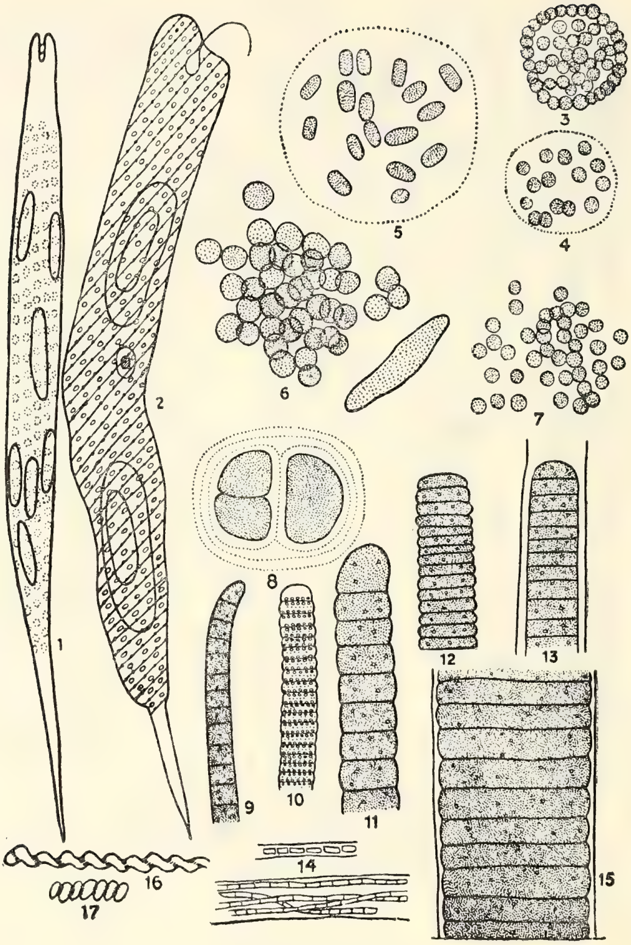
BOMBAY ALGAE.

Fig. 1.—*Cosmarium Lundelii* Delp. var. *ellipticum* West. (×406).
Fig. 2.—*Cosmarium cucumis* (Corda) Ralfs. var. *magnum* Racib. (×262).
Fig. 3.—*Cosmarium Quadrum* Lund. (×406).
Fig. 4.—*Cosmarium sublatere-undatum* West & West (new var.) Front and vertical views. (×406).
Fig. 5.—*Cosmarium angulatum* (Perty Rabenh. forma *major* Grunow. (×182).
Fig. 6.—*Cosmarium granatum* Bréb. (×406).
Fig. 7.—*Cosmarium divergens* Krieger (new var.). (×406).
Fig. 8.—*Cosmarium contractum* Kirch. var. *ellipsoideum* (Elfv.) West & West. (×406).
Fig. 9.—*Cosmarium Meneghinii* Bréb. (×406).
Fig. 10.—*Cosmarium Portianum* Arch. (×406).
Fig. 11.—*Cosmarium abruptum* Lund. (×406).
Fig. 12a.—*Cosmarium subimpressulum* Borge. (×406).
Fig. 12b.—*Cosmarium subimpressulum* (vertical view). (×406).
Fig. 13.—*Cosmarium phaseolus* Bréb. var. *elevatum* Nordst. (×406).
Fig. 14.—*Cosmarium sexnotatum* Gutw. var. *tristriatum* (Lutkem). Schmidle. (×406).
Fig 15.—*Cosmarium cymatopleurum* Nordst. (×406).



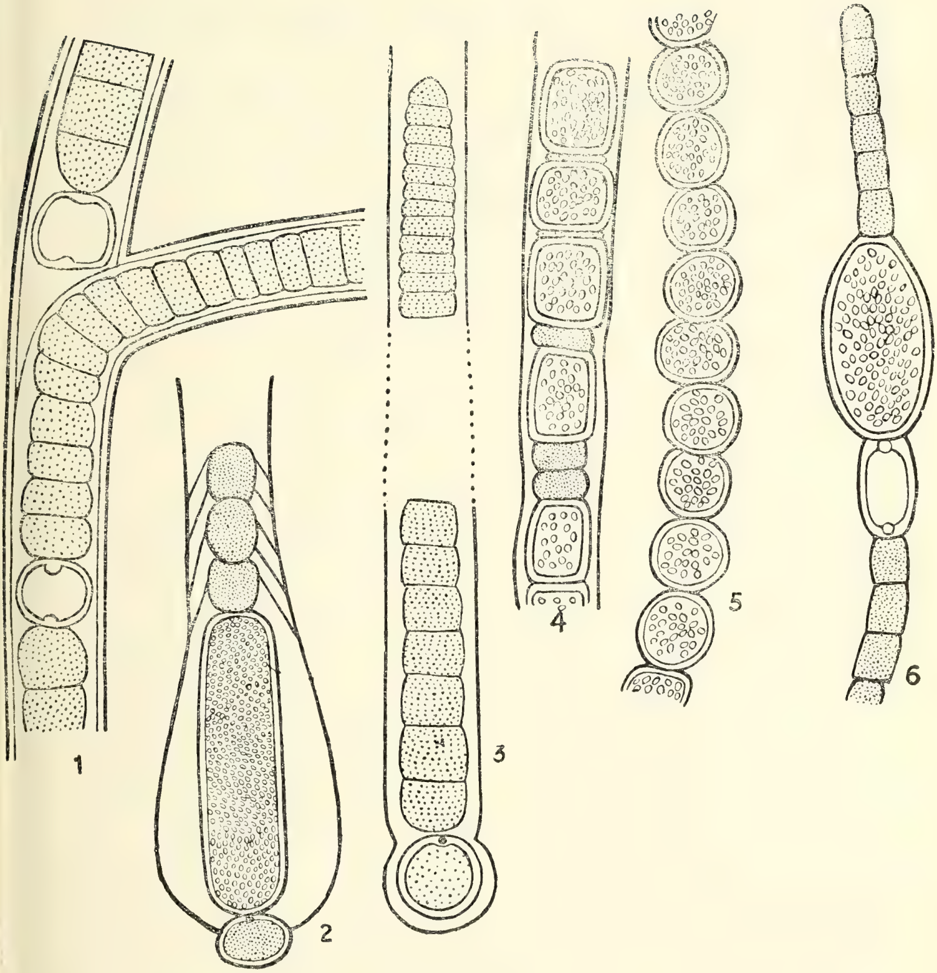
BOMBAY ALGAE.

Fig. 1.—*Bubochaete rectangularis* Wittr. var. *hiloensis* Nordst. (×406).
Fig. 2.—*Oedogonium iowense* Tiffany. (×182).
Fig. 3.—*Oedogonium longicolle* Nordst. (×406).
Fig. 4.—*Oedogonium decipiens* Wittr. forma *dissimile* Hirn. (×182).
Fig. 5.—*Oedogonium varians* Wittr. & Lund. (×182).
Fig. 6.—*Oedogonium inconspicuum* Hirn. (×406).
Fig. 7.—*Euglena Ehrenbergii* Klebs. (×182).
Fig. 8.—*Euglena proxima* Ehr. (×406).
Fig. 9.—*Euglena deses* Ehr. (×182).
Fig. 10.—*Lepocinclis Bütschli* Lemm. (×406).
Fig. 11.—*Lepocinclis Bütschli* Lemm. var. *angustata* Delf. (×406).
Fig. 12.—*Lepocinclis ovum* (Ehr.) Lemm. (×406).
Fig. 13.—*Phacus orbicularis* Hub. (×406).
Fig. 14.—*Trachelomonas horrida* Palmer var. *crenulatocollis* Skvor. (×406).
Fig. 15.—*Trachelomonas armata* Ehr. var. *Steinii* Lemm. (×406).
Fig. 16.—*Trachelomonas similis* Stokes. (×406).
Fig. 17.—*Trachelomonas volvocina* Ehr. (×406).



BOMBAY ALGAE.

Fig. 1.—*Euglena acus.* Ehr. (×406).
Fig. 2.—*Euglena oxyuris* Schmarda. (×262).
Fig. 3.—*Coelosphaerium Kuetzingianum* Näg. (×406).
Fig. 4.—*Aphanocapsa ellachista* W. & G. S. West var. *conferta.* (×406).
Fig. 5.—*Aphanothece pallida* (Kūtz.) Rab. (×406).
Fig. 6.—*Microcystis flos-aquae* (Wittr.) Kirch. (×406).
Fig. 7.—*Microcystis stagnalis* Lemm. (×406).
Fig. 8.—*Chroococcus turgidus* (Kūtz.) Nāg. (×406).
Fig. 9.—*Oscillatoria gloeophila* Grun. (×406).
Fig. 10.—*Oscillatoria tenuis* Ag. (×406).
Fig. 11.—*Oscillatoria chalybea* Mert. (×406).
Fig 12.—*Oscillatoria sancta* Kūtz. (×406).
Fig. 13.—*Lyngbya aestuarii* (Mert.) Lemm. (×182).
Fig. 14.—*Schizothrix lacustris* A. Br. (×406).
Fig. 15.—*Lyngbya Birgei* Smith. (×406).
Fig. 16.—*Spirulina subtillissima* Kūtz. (×406).
Fig. 17.—*Spirulima major* Kūtz. (×406).



BOMBAY ALGAE.

Fig. 1.—*Tolypothrix distorta* (Fl. Dan.) Wartm. (×406).
Fig. 2.—*Gloeotrichia Raciborskii* Wolos. (×406).
Fig. 3.—*Calothrix marchica* Lemm. var. *crassa*. Rao. (×406).
Fig. 4.—*Aulosira fertilissima* Ghose (showing spores). (×406).
Fig. 5.—*Anabaena fertilissima* Rao. (×406).
Fig. 6.—*Anabaena Fülleborni* Schmidle. (×406).

MISCELLANEOUS NOTES.

1.—RARITY OF MAN-EATING TIGERS IN SOUTH INDIA.

In your April 1945 number Lt.-Col. E. O'Brien raises a question which has puzzled many. Why are Man-eaters so rare in South India?

There have been, and may still be, many man-eating tigers in the Ganjam District, of course, and part of this district is south of a line drawn due east from Bombay. Vizagapatam District has had its man-eaters, and also other parts of the 'Agency Tracts'.

The Nallamallais, Kurnool District, provided the man-eating tigress shot eventually at Diguvametta by the then Conservator of Forests in September 1923. She preyed upon the luckless railway gangmen; and this habit brought about her death. The Conservator was told to walk along the railway embankment keeping a sharp lookout on both sides. He soon spotted the tigress making for a culvert ahead of him. He walked towards the culvert, and then over to the other side of the embankment: and stopped. The tigress, misjudging his position, popped up ahead; and received her quietus. She was in good condition, but carried an old scar.

A man-eater roamed the Baragur Hills, to the east of the Biligirirangans (Coimbatore District), some 30 to 35 years ago; killing people spasmodically—about 4 or 5 a year. A Government Notification offering a reward for the brute described it as 'Ashy-grey, and somewhat stout'! It was said to have been shot by a poacher: if so it was quickly succeeded by another man-eater (not an unusual case) which also killed humans at infrequent intervals from Talamalai north-eastwards to Madeswaram-malai and Ponnachi (Kollegal Taluk, Coimbatore District). Lt.-Col. R. E. Wright and I went after this tiger, reputed to have a kink in its tail. One night our camp was pitched in a field at the western foot of the Baragurs, an ill-chosen spot infested with masses of hairy-caterpillars. We went to sleep in two small tents facing each other, with a 'Petromax' lantern burning between the tents; and loaded rifles by our cots. I was awakened at midnight by a horrified yell from R.E.W. and rushing out, collided with him; on which he collapsed with laughter. Half-asleep he had imagined seeing a large form stealthily moving into his tent; it turned out to be the shadow cast by the petrol lamp on the wall of the tent, of a large caterpillar crawling over his bed clothes!

Now this tiger *was* shot by a poacher. Sallying forth after deer in the early morning he met the tiger round a corner, fired his muzzle loader at it, dropped the gun and fled like the wind. Later in the morning a Forest Guard and his watcher, on beat duty, came on the dead tiger, and recognized it as the man-eater. The gun was also recognized by the watcher who named its owner. So a bargain was struck. The poacher was told that he would not be reported for being in the Reserve Forest with an unlicensed gun, provided the Forest Guard was given the skin and skull of the tiger. This was gladly agreed to by the poacher who had no idea that the tiger was a notified man-eater, with a reward of Rs. 300 on its head. The F. G. then proceeded to claim the reward, producing the skin and skull in the local Katchery together with a wonderful story of how he had killed the tiger single handed sitting up for it over a jungle path. The reward was about to be paid when the watcher learned that the F.G. intended to give him a mere pittance of the total. So the watcher then 'blew the gaff'. The only party to benefit was an unkind Government who, while pardoning the poacher for his activities, confiscated his gun and paid out no reward—the F.G. being sacked, and the tiger's skin and skull retained in the Katchery.

In more recent times, two years ago in fact, a tiger killed four or five people at the western foot of the Billigirirangans (Mysore District) and was finally shot by officials. Earlier this year a tiger killed three persons in the Talavadi firka, Gobichettypalayam Taluk, and was finally shot in Mysore territory.

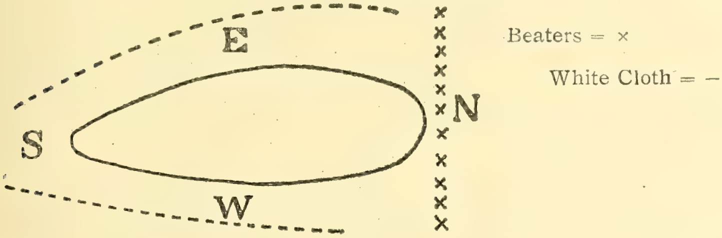
The foregoing still does not explain why there are fewer man-eaters in South India—but I think the answer possibly lies in a combination of circumstances. Continued existence of man-eaters in an area where both game animals and cattle exist in insufficient numbers, and where tiger are forced to remain instead of emigrating to more fruitful parts—as in the case of Ganjam for example. Sanderson's description of the Honganur (Mysore District) man-eating tigress (in his 'Thirteen Years among the Wild Beasts of India'), which he finally shot, is an example of the vice picked up by a tigress to provide easy food for her cubs in all probability. It is a recognised fact that the villagers and jungle tribes of South India have not got the 'guts' of those of Central and North India. They are less inclined to stand their ground on the appearance of tiger after their cattle, and in the proximity of a tigress with cubs. This I think, has resulted in more herdsmen and villagers being killed by tiger, or tigresses (so attaining an inherited taste for humans), in the Central and Northern parts of India.

HONNAMETTI ESTATE,
ATTIKAN P.O., R. C. MORRIS.
VIA. MYSORE,
13th December 1945.

2.—MAN-EATERS IN THE DARRANG DISTRICT, ASSAM

During the past two or three years nearly 50 people have been killed and eaten in this district. A kill would take place and when next heard of, the tiger would be a distance of nearly 10 miles away making it very difficult to bring the animal or (animals) as turned out to be, to bag.

A man was killed one evening and the next morning the villagers reported that the tiger was in their *bari*. On arrival at the village, just off a main road—the men pointed to a small hedge of thatch and scrub jungle four feet wide and about the same in height. On approaching to within six feet I saw a tiger crouching. The tiger turned out to be an old emaciated male, 8′ 10″ in length, —blind in one eye and covered in old bullet and *dao* wounds. For a time killings ceased, but after a period of three months or so a man was reported killed. A few days afterwards villagers from near where the killing took place reported they had a tiger surrounded in a patch of jungle 5 or 6 acres in area. I lined the east and west side of the jungle with strips of white cloth put a line of drummers and beaters at the north end and waited in the neck at the south end.



Nothing happened until the beaters were half way through, then the tigress broke to the west, saw the white cloth, and entered the jungle again, after a short time it broke east then turned back into the jungle. When the beaters reached within 10 to 15 yards of the south end the tigress broke cover and came roaring towards me, when she was bowled over. A tigress in fair condition with L.G. wounds in her shoulder and blind in one eye ! ! !

A short time afterwards I was out on an elephant near where previous killings had taken place and came on a tigress which, after shooting, was found to be an eight feet old emaciated tigress, also blind in one eye.

No killings have taken place for 3 or 4 months and it looks as if the last of the man-eaters is accounted for.

The extraordinary thing is the three tigers being blind in one eye.

Have any of your readers heard of a similar case.

THE BORPUKHURIE TEA COMPANY, LTD.,
MIJIKAJAN P.O. & T.O.,
DISTRICT DARRANG, ASSAM,
27th October 1945.

D. G. MESTON.

3.—DEATH OF A PANTHER ON A TIGER'S KILL.

On 30-3-33 I wrote a description of a tiger pouncing on a dead panther (which I had shot) on discovering it along-side his kill.

A dead panther, killed by a tiger (but not eaten) has been found within a few yards of the latter's kill here recently. The tiger had killed a cart-bull on a forest road and dragged it into the jungle. That night a panther located the kill, and, unaware of the tiger's approach, obviously fell an easy victim.

Some years ago I wrote a note on the more cautious behaviour of a panther which had designs on a tiger's kill. It climbed the tree on which I was sitting (together with a lady) and actually perched itself above us. I was terribly sleepy at that time; and, awakened by her nudge, and alarmed whisper of 'what's that above us?' I murmured 'only a panther' and drowsed off again—only to be properly awakened this time with a thump and loudly spoken 'How awful; wake up'! The panther leapt down off the tree; and the tiger did not turn up!

HONNAMETTI ESTATE,
ATTIKAN P.O.,
VIA. MYSORE, S. INDIA,
10*th December* 1945.

R. C. MORRIS.

4.—SENSE OF SMELL OF TIGER AND LEOPARDS.

There appears to be a lot of controversy over this. I have killed over fifty leopards and tigers from sitting in holes in the ground, have had tiger within a foot or so of me and only on one occasion has a tiger shown any interest.

After sniffing loudly several times, apparently satisfied, it proceeded to the kill, a dead buffalo.

I had over the hole (3′ square) a few bamboos and a thin thatch covering, so had the animals' power of scent been at all good they would surely have detected me.

It would be interesting to hear of other readers experiences.

THE BORPUKHURIE TEA COMPANY, LTD.,
MIJIKAJAN P.O. & T.O.,
DIST. DARRANG,
ASSAM,
10*th October* 1945.

D. G. MESTON.

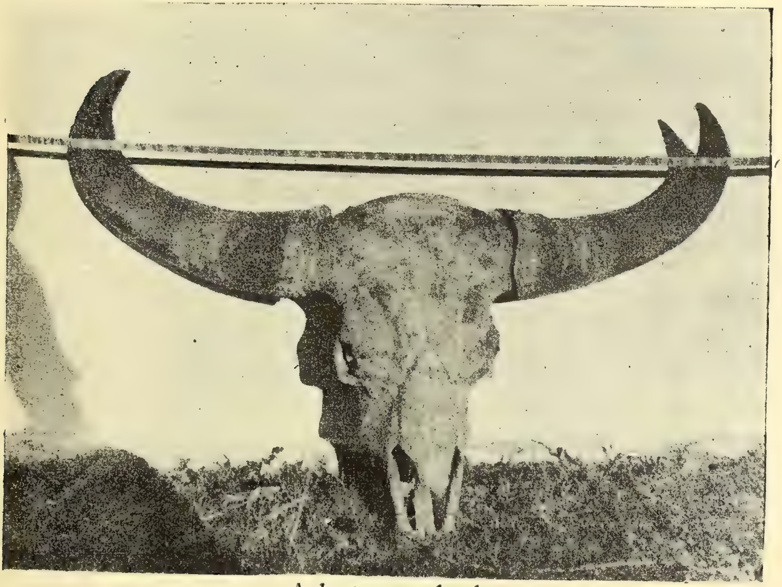
5.—MUSK-SHREW (*SUNCUS CAERULEUS*) ATTACKING BULL-FROG (*RANA TIGRINA*).

A few days ago, soon after sunset, as I was sitting in my garden, my attention was attracted by the rasping croak of a big frog in distress: This peculiar sound is usually emitted when frogs are caught or are in the act of being swallowed by snakes and monitor lizards. As it was then getting dark, I called for my car and directed the head-lights towards the hedge from whence the sound was coming, and calling my Arab watchman I approached slowly for investigation. No sooner had the car-lights been focussed on to the hedge, a large frog (*Rana tigrina*) leaped out into the open, and immediately following it a small rat appeared and soon teeth fixed itself on the back of the frog. The rat had now fastened its teeth in the nape of its prey and there was the frog again emitting its pathetic cry. My Arab struck the rat with a stick as soon as it was separated from the frog, and the rat being killed, the frog leapt back into the hedge. On inspection I was surprised to identify the 'rat' to be a Musk-Shrew (*Suncus caeruleus*). I have never even seen a common rat attacking a frog much less a 'Muck-rat'.

BHAVNAGAR, K. S. DHARMAKUMARSINHJI.
13*th October* 1945.

6.—A LARGE GAUR HEAD.

(*With a photo*)



A large gaur head.

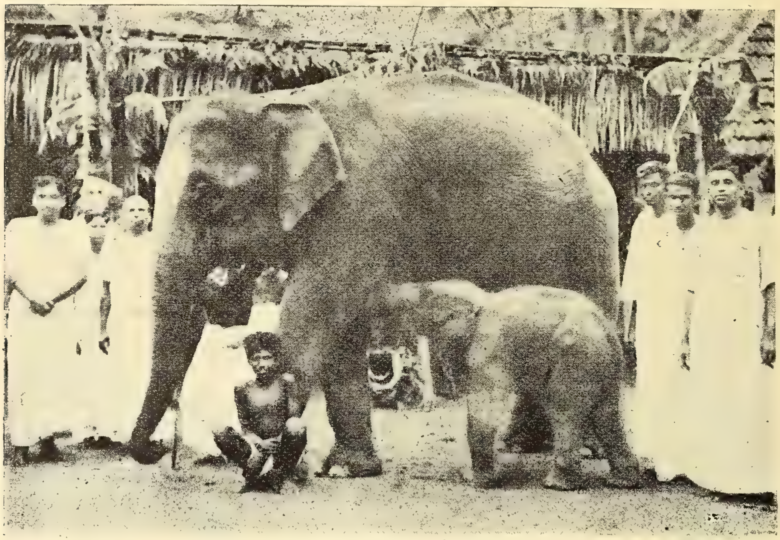
We enclose a photograph of a Gaur Head (*Bibos gaurus*) shot by H. H. the Raja Saheb of Korea State, Central India and feel sure it will be of interest to your readers.

Greatest width 45″
Length from tip to tip 72″
Left horn 28″
Right horn 27½″
Circumference at base of horns 17½″.

MYSORE S.I., VAN INGEN & VAN INGEN.
19*th December* 1945.

7.—PERIOD OF GESTATION OF THE INDIAN ELEPHANT (*ELEPHAS MAXIMUS*).

(*With a photo*).



Indian Elephant with newly born calf.

An interesting elephantine romance was brought to my notice by Mr. A. S. M. Nair, Commissioner, Hindu Religious Endowments Board, Madras. According to the very reliable reports he had obtained, a female elephant belonging to the Sri Emuri Bhagavati Temple, at Kallekulangara, near Palghat, in the Malabar District, was covered by a wild tusker, on or about the 19th November, 1938. The tusker came probably from the outskirts of the Olavakkot forest to the place where the cow elephant was tethered. The tusker remained with the cow elephant for three days, and the courtship and mating were watched by the inhabitants of the locality. The report that the tusker did not eat a morsel of food during the three days has not been verified by me. Efforts made to capture it by doping seem to have failed because of the tusker's extreme wariness. The tame female elephant calved on Friday 6th September 1940—this date was noted by the Manager of the temple, Mr. E. Chathu Achan, of Akathethara village—and the baby tusker, now about five years old, is said to be thriving. In the photograph reproduced here (which was very kindly lent to me by Mr. Nair), the baby elephant can be seen sucking its mother's milk.

The period of gestation in this case is about 21 months and 18 days. In the case of a male calf reported by Corse (*Tr. Roy. Soc.* 1799) it was 20 months and 18 days.

I was informed by the Manager of the temple that in August 1945, the same wild tusker came again to the old spot to meet the female elephant, and this time it was driven away with the greatest difficulty. The people of Malabar are so elephant-minded that reliance can be placed on their identification of the tusker as the one they knew in 1938.

GOVT. MUSEUM,
EGMORE, MADRAS, A. AIYAPPAN.
20th November 1945.

8.—BIRTH OF AN ELEPHANT CALF.

Reading in the Miscellaneous notes of the *Journal* of the B.N.H. Society, on page 183 of Volume xxxviii, of the birth of an elephant calf on the bank of the Menik Ganga in Ceylon, brought to my mind an experience of my own on X'mas day 1903 in the Anamalai Hills, near Coimbatore. On that day, about 9 in the morning, the late Mr. G. A. Marsh and I went to visit a small plantation of bananas, on the Paralai Estate, which had been damaged by elephants. Hearing a herd of elephants a considerable distance away in the jungle making a tremendous amount of noise, much more than usual,—trumpetting, squealing, breaking of branches etc., we decided to investigate, and proceeding towards the herd, which could not be seen owing to the extremely dense jungle, we soon found a wild fig tree, very easy to climb, on one of the branches of which, about 25 feet above the ground, we perched ourselves. Shortly after this, three female elephants came up to our tree, and one of them entered a cane brake, (*Eeta*) right under the branch on which we were sitting. The other two remained outside the clump of *Eeta,* apparently keeping guard, for on the approach of other members of the herd, (it was a fair sized herd of about 30 animals we thought) they were definitely warded off. After a time —about half an hour—the two guards went away, but we could not descend from our tree because we knew the third elephant was still in the cane below us. We were very mistified as we could not even guess at what was happening. We waited there for a full hour, at the end of which the third elephant emerged, went a few steps, put its trunk to the ground and made that peculiar drumming noise, one so frequently hears an elephant make. At once a very small calf came out from the cane, and went with slow steps towards its mother. It was wet and shiny, but not very dark skinned. It was suckled for a short while, when the mother moved on towards the direction of the herd which was by then a quarter to half a mile away, still making much more noise than usual.

When we considered it safe to do so, and the mother and calf had disappeared, we descended from the tree and inspected the cane brake. We found the placenta there—a very pale pink, and weighing, we judged, about 10 lbs. This placenta looked rather like pale raw liver. There were two or three very much thickened portions, roundish in shape, about 3 inches in diameter which we judged might have been the attachment of the placenta to the body of the mother. These thicker portions were between $\frac{1}{2}$ to $\frac{3}{4}$ of an inch thick, but the rest of the placenta was much thinner—not more than 1/16th to 1/8th of an inch.

By this time it was noon and we went home. We had no weapons with us. Unfortunately the cane brake was so thick that we could not see the actual birth of the calf, and so are unable to state whether it was delivered by the mother standing, or lying down, but judging from the marks we saw, we thought the mother must have been kneeling. So far as we could guess, the calf when it came out of the cane was about the size of a half grown wild pig.

I am afraid these notes do not add much if anything to our knowledge of the subject, but they may be interesting to some members.

28, Lalbagh road, J. R. VINCENT.
Bangalore,
9th October 1945.

9.—THE ASHY SWALLOW-SHRIKE (*ARTAMUS FUSCUS*) IN THE NILGIRIS.

On April 26th 1944, I watched a pair of the Ashy Swallow Shrike (*Artamus fuscus*) at Kotagiri in the Nilgiri Hills and at an elevation of 6,300 ft. They were on a dead Eucalyptus tree and may well have been breeding, since they were very pugnacious, driving off crows and kites which came near. I put this on record as this species does not seem to have been recorded much above 5,000 ft.

2, Assam Regt., C. R. STONOR,
11, A. B. P. O., *Major.*
November 1945.

10.—OCCURRENCE OF THE WHITE-BELLIED OR SNOW PIGEON (*COLUMBA LEUCONOTA LEUCONOTA*) AT A LOW LEVEL IN THE KUMAON HIMALAYA.

Early in January 1945, there was an unusually heavy snowfall in the Kumaon and Garhwal Himalaya in the United Provinces, snow incidentally falling in Dehra Dun at 2,000 feet and down to as low as 1,600 feet in some of the deep valleys of the outer hills. Later that month I was touring in the eastern part of Almora District, and on January 30th I was in the Sarju valley near Nali forest rest house (about half way between Rameshwar and Bageshwar), where the river runs at about 2,200 feet and the road is some hundreds of feet above the river. Here I came across a flock of 8 snow pigeon (*Columba leuconota leuconota*) feeding on a grass slope between the road and the river. Snow had by then melted in most places below about 6,000 feet. I have often seen and shot this species at high levels near the snow peaks between about 10,000 and 13,000 feet, and the distinctive grey, white and black plumage was unmistakable even at some distance. But I shot 4 of them and made certain by a reference to the Fauna of British India that my identification was correct.

I have toured for many years both in summer and winter throughout the U.P. Himalaya and I cannot remember ever seeing this snow pigeon except at high levels near the main snow range, and certainly not much below 9,000 feet or more than 5 to 10 miles from the permanent snow level. But here was a flock at an elevation of less than 2,500 feet and 35 miles in a direct line from the nearest permanent snow. It is probable that the exceptional snowfall earlier in the month had driven them to lower levels, but I feel that this occurrence at such a low elevation and so far from their usual habitat is worth recording. The habitat given in the Fauna of British India is 'between 10,000 and 12,000 feet and less often a thousand feet higher or lower', which agrees with my usual experience, and the lowest occurrences mentioned are 5,000 feet in Chitral and 7,000 feet in Kashmir.

NAINI TAL, D. DAVIS, I.F.S.,
U.P., *Conservator of Forests.*
2nd November 1945.

11.—MIGRATION OF THE MALLARD (*ANAS PLATYRYNCHA*): RECOVERY OF RINGED BIRD.

A Mallard (*A. platyryncha*) was shot at Sakrand Lake, Nawabshah, Sind, on the 14th January 1945, bearing one of the rings of the Bird Banding Bureau, Moscow. The incident and description of the ring and serial number was sent to the society by Mr. Hardit Singh, Inspector of Agriculture, Nawabshah Sind. Subsequent correspondence with the Director of the Russian Bureau, elicited the information that the Mallard was ringed 'as a moulting bird at the Astrakhan State Reserve, near Astrakhan, delta of the Volga River'. The date of ringing was not specified.

EDITORS.

12.—OCCURRENCE OF THE PINK-FOOTED GOOSE (*ANSER FABALIS BRACHYRHYNCHUS* BAILLON) IN INDIA: AN AUTHENTIC RECORD.

I am sending the skin of a goose shot by His Highness today in Bikaner. It has not been possible for us to identify it. Will you kindly therefore examine the skin very carefully and let me have your opinion for His Highness' information as to what species of goose it is.

It is possible that it may be a hybrid. On the other hand it is also possible that it may be a young Dwarf Goose. But in the plate given in Hume and Marshall's book opposite page 77 there appears to be no black tip to the beak which this bird has. On the other hand the beak in the plate is yellowish in colour, whereas in the bird it is pinkish.

The black wing and tail feathers seem to tally more with the Dwarf Goose than any other. It also has yellow legs. On the whole it appeared to be a bird not bigger than a Barr-headed Goose, and if anything slightly smaller.

Thanking you for the favour of an early reply.

LALLGARH, BIKANER, PRIVATE SECRETARY TO
RAJPUTANA, H.H. THE MAHARAJA OF BIKANER.
1st December 1945.

[On examination of the above-mentioned specimen considerable difficulty was experienced in establishing its true identity as the colouring of the soft parts described by E. C. Stuart Baker (F.B.I., Vol. 6, p. 402) applies to the typical race *A. f. fabalis.* At the same time under the heading of 'Habits', he writes, 'Records of the occurrence of this goose (*Anser brachyrhynchus*) in India are comparatively numerous but there can be little doubt that the great majority of these refer to the next bird *Anser neglectus* or, perhaps, to some other Bean-Goose. In 1849, Blyth recorded the Pink-footed Goose in the Punjab; in 1864 Hume shot two specimens believed to have been this species in the Jumna, and Irby records one having been killed near Lucknow in 1858. In 1879 Hume again recorded it. General McLeod says that in 1853 he shot one near Gurdaspur in the Punjab. The only record, however, which applies without doubt to the Pink-footed Goose is that of the one shot by one of my collectors in the Sarrma Valley, Assam. The smaller bill of this specimen, 40.60 mm.,[1] alone is sufficient to show that it was not one of the bigger Bean-Geese. The small bill of *A. f. brachyrhynchus* certainly appears to form a good distinction between it and the larger bill of *A. neglectus,* Sushkin's Goose (culmen 55-63 mm.) which resembles it in plumage'.

However, C. B. Ticehurst, commenting in the *Journal* on the *Fauna of British India*: Birds (Vol. 34, p. 489) doubts Baker's Assam record. He opens his notes on *A. brachyrhynchus* with a question. His remarks are as follows:—

'Is there any specimen of this goose from India in existence? If not, it should be deleted from the *Fauna.* The Pink-footed Goose is a bird of rather limited and distinctly westerly distribution in winter at which season, according to Buturlin, there is not a single record so far east even as European Russia. What the Goose obtained in Assam was with a bill of 40.6 mm. I cannot say; this is too small a bill for the Pink-footed Goose, 15 of which in my collection measure 43-50 mm.'

Perhaps the last word on the subject is to be found in the *Handbook of British Birds*, Vol. III and we can do no better than reproduce the passages dealing with the essential details of both the typical race, *A. fabalis fabalis* and *A. f. brachyrhynchus*, the sub-species with which we are concerned:

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[1] Probably a misprint for 46 mm.

Anser fabalis fabalis (*Lath.*).

Measurements: '♂ wing 447-498, mm. tail 117-145, tarsus 71-87, bill from feathers 56-66, ... ♀ wing 424-452, bill 51-60, l.c. p. 196.

Distribution: 'Typical race passes through Europe to winter in Mediterranean (rarely N. Africa), Black and Caspian Seas; also Asia Minor, Palestine, Persia to Turkestan. Eastern races winter in N. China and Japan. Casual in Madeira and Egypt.'

Anser fabalis brachyrhynchus:

Measurements: '♂ 417-490 mm., tarsus 69-83, bill from feathers 41-54 (36 measured). ♀ wing 395-454, bill 37-48 (32 measured.)' Tail 16-18 feathers.

Colouring of soft parts: 'Legs and feet (ad.) flesh-pink to bright pink (sometimes almost purple. Caton-Haigh), (juv.) on first arrival (Sept.) usually pale pink or dull reddish-grey but many are yellow ochre or ochreous—flesh gradually changing to pink during first winter (Coombes);' l.c. p. 200.

Distribution: Breeds only in N. E. Greenland, Iceland and Spitsbergen. Winters in France (rare) Belgium, Holland, Germany, and occurs (or on passage) Jan Mayen, in Faeroes, Bear Island and Scandinavia. Accidental in Switzerland, Austria, Italy, Cz.-Slovakia, Baltic States, Hungary, Y. Slavia, Roumania, N.W. & S. Russia. Once U.S.A.

Very possibly the specimen referred to by Baker has not been preserved or, if preserved, mislaid. As he gives the measurement of the bill (40.6 mm.) he must have handled the specimen himself. Being a competent ornithologist, Baker must have known the species he was handling at the time. Baker's measurement falls well within the range recorded in the *Handbook of British Biras* for *brachyrhynchus* females, and even the slight difference of under 4 mm. is really negligible considering that the method of measurement may vary with individuals.

The measurements of the bird sent to us from Bikaner are: wing 395 mm., tarsus 82 mm., bill from feathers 46 mm., tail 135 (18 feathers), nail 12 mm. All the measurements suggest that this bird is a female of the species *A. f. brachyrhynchus*. Eds.]

13.—SOME COMMON BIRDS OF KATHIAWAR—ABSENT OR RARE IN KUTCH.

Mr. Sálim Ali's 'Birds of Kutch' has shed a valuable flood of light on the bird life of that area and in the side-light I cannot help comparing the bird-life of my province, Kathiawar.

The learned author has pointed out that the Great Rann is an effective barrier to the local movement of birds in Kutch. It would be interesting to know to what extent, if any, the Little Rann presents such a barrier. I am inclined to think that there might be a free seasonal movement of birds to and from the adjacent areas of North Gujarat and Kathiawar over the Little Rann. If that is true, I wonder why some of the common birds of Kathiawar are absent or rare in Kutch, while others are as common in Kathiawar as in Kutch. This appears to be strange when we view it against the background of physiographical, climatic and floral conditions, which are almost identical in Kutch, Kathiawar and N. Gujarat. We are told that the resident birds of Kutch, as also the local migrants, approximate more closely to the birds of Gujarat and Kathiawar. There seems to be no reason, therefore, to justify the absence of such common birds as the Jungle-crow, the Tree-pie and the Crow-pheasant from Kutch. This question may take us to the origin of species of birds in Kutch and if Mr. Sálim Ali will throw more light on the question I should not be disappointed in expecting very valuable and interesting information.

Giving some specific instances, I wonder what prompted the Jungle-crow to make a 'peaceful penetration' into Kutch recently where it was absent so long. The Tree-pie is not rare in afforested areas and gardens in the three adjacent provinces. During my flying visit to Kutch a couple of years ago I saw beautiful gardens and 'wādis' near Mandvi and Bhuj, but I cannot imagine why they have not attracted the Tree-pie.

The Jungle babbler presents a different problem, as also the Rosy Pelican. If the former once flourished in Kutch it is difficult to know the reason why it left the benevolent protection of the bird-loving rulers of Kutch. Mr. Sálim Ali observed the Pelican at Mithapur in N.W. Kathiawar, but not in Kutch where it was observed by Lester in 1893. The bird is a common winter visitor to the backwaters of the west coast of Kathiawar, and on my way to Kutch I saw a party on the Miani creek about half way between Mithapur and Porbander. When I was stationed at Navibunder, some distance south of Porbander, I observed that the Pelican was the earliest bird to arrive there on the tidal waters of the mouth of the Bhadar, the biggest river of Kathiawar. A party of about 50 birds arrived there in the last week of August and disappeared next day, leaving a few to spend the cold weather there. One of them tried to swallow a fish too big even for its bulky bill and pouch and the misadventure cost the greedy bird its life. I wonder why the Pelican, on its way to Kathiawar, should rule out the creeks of Kutch.

Mr. Sálim Ali informs us that the Coucal or Crow-pheasant was recently introduced into Kutch from Jamnagar under the name of 'Jamnagar crow'. I have observed in Kathiawar that the Coucal inhabits even distant and isolated gardens in barren tracts. In fact it is so well known there that it has its local name which appears to have been adopted in English. Another remarkable absentee is the Magpie Robin, which Kutch is unlucky to miss inspite of localities quite suitable to this pretty bird. Barring some semi-desert regions in Kathiawar, every garden there claims the patronage of this beautiful songster.

As in Kutch so also in Kathiawar, the Paradise Flycatcher is a rare straggling passage migrant and I have seen only one specimen in a garden in the heart of Porbander.

The distribution of the Bank Myna is remarkable. While it is uncommon and patchy in Kutch, it is more common than the Common

Myna in Gujarat, tolerably common in E. Kathiawar and only a winter visitor in W. Kathiawar. The Pied Crested Cuckoo, though fairly common in Kutch, is unknown in Kathiawar except some well shaded areas near Bhavanagar and, probably, Junagadh. On the other hand, while the Coppersmith is a *rara avis* in Kutch I cannot imagine a *Ficus* tree in Kathiawar not visited by this ventriloquist.

Besides the Pelican, I must arraign the White Stork for shunning the domains of the Maharao and selecting the scanty marshes of Kathiawar, where not many rulers have the love for birds at their heart. While travelling from Jamnagar to Ahmedabad I saw a flock of white storks in the month of May! Again, while taking a morning walk to observe bird-life at Than in N. E. Kathiawar I saw a party of white Storks busy with their morning breakfast. This was in September.

Want of space forbids me to prolong these notes, but I cannot close these lines without stressing the importance of the west coast of Kathiawar in relation to the migration of birds for many of which it is a passage route. With thrill and delight I remember the days of my boyhood when we enjoyed the pleasure of observing these annual migrations. Birds flew over even at night, and while the sonorous and shrill trumpetings of cranes, resounded in the cool air, we craned our necks in vain to pick up a glimpse of the birds against the canopy of the starspangled sky. It is important to note that I have never seen their return flights in spring. This shows that, as in Kutch so also in Kathiawar they take a different route on their return home.

Let me hope that one day some enthusiastic ornithologist like Mr. Sálim Ali will get an opportunity to survey the avifauna of my Province and give us surprising and interesting wealth of information.

ANDHERI, V. M. VASU,
11*th January* 1946. *Advocate.*

14.—'BIRDS OF VIZAGAPATAM DISTRICT'—SOME NOTABLE OMISSIONS.

The contribution to the September issue of the Society's *Journal* by Mr. Humayun Abdulali on the birds of Vizagapatam District (Vol. 45, p. 333) has filled a notable gap in the ornithological records of India. It is indeed surprising that in spite of the Vernay Survey there should have hitherto been such sparse records of the bird life of this large and important district. The Vernay Survey for instance reported that there was no record of three very common birds, the Green Bee-eater, the Pied King-fisher and the Blue Jay, in the Madras Presidency north of the Godavari. All three of these birds can be seen in considerable numbers from the windows of the Madras-Calcutta mail as it passes through the Vizagapatam District. I worked in the Vizagapatam District for two or three years, and from my observation there would say that the Pied King-fisher and the Blue Jay are more common there than in any other district of the Presidency. There are two items of information I should like to add to Mr. Abdulali's article. The Grey Hornbill is not uncommon in the plains of the district, and I remember to have seen it frequently near Palkonda, in particular. Also I saw a pair of Great Hornbills in dense jungle near Lotugedda in the Agency tracts in September 1930. Although I read in a back number of the *Journal* (xxxvii No. 4) that there was no record of these birds being found on the eastern side of the Madras Presidency, I can positively assert that I was not mistaken.

The notes of Mr. La Personne on the birds of Salem district in the Vernay Survey are very complete. But I am sure much valuable information could be gathered if an expert paid a winter visit to the district. Throughout the cold weather a blue rock-thrush is to be seen at or about the same point on the ghat road to Yercaud, some 3,500 feet above sea-level. It disappears about the end of April, and this year I saw it again on the 1st October. On the 8th October last year a pair of Black Redstarts appeared in my garden. They were gone the next day, and I have not seen the bird this year. The Blue-tailed Bee-eater puts in an appearance in large numbers with the north-east monsoon. This year the first arrivals were noticed on 6th October. The Green Bee-eater is of course numerous throughout the year, but the Chestnut-headed Bee-eater seems to be rather commoner in summer than in the winter or the rains. It is perhaps worth noting that the Brahminy Myna is extremely common in and around Salem, whereas during a stay of a year and a half in the adjacent district of Coimbatore I never saw a single specimen. In December last year a wedge of a dozen or more wild geese was seen flying southwards over the middle of Salem town. The Vernay Survey expresses some doubt regarding the occurrence of the Common River Tern in Madras. Terns (presumably belonging to this species) can be seen in fairly large numbers—together with cormorants and one or two herons—on the Cauvery river at Hogainakal. There are also terns and cormorants below the Mettur dam on this river.

Even in my own compound of some half a dozen acres the variety of birds that can be seen is quite remarkable. For example I may mention that Ashy Swallow-shrikes perch every evening, huddled close together, on the wireless aerial. The Wood-shrike's distinctive call can be heard almost daily. The Bay-backed Shrike, the Black-headed Cuckoo-shrike, the large Cuckoo-shrike, and the great Grey Shrike all visit the compound, some of them frequently.

I should be very glad to offer hospitality to any observer whom the Society might depute to pay a visit to Salem.

COLLECTOR'S BUNGALOW,
SALEM,
6th November 1945.

R. C. BELL, I.C.S.

15.—THE BIRDS OF BURMA.

[*A reply to Major B. E. Smythies' note* (Vol. 45, p. 448).]

May I reply briefly to Major B. E. Smythies' courteous criticism of my monograph on the vegetation of North Burma in the September *Journal.*

In the first place I did him less than justice both in my remark that he had not visualised North Burma, and in my suggestion that he had underrated the avifauna of that region. The former error is perhaps pardonable as I believe Smythies' journeys (worthy of a pioneer explorer) were actually made after the publication of the *Birds of Burma* and I did not fully appreciate his geographical sense. My excuse for the latter must be his own modesty in disclaiming any credit for his book. I have since learnt that a large share of the credit is due to him, and from letters I have received from him, as well as from his published work I have come to realise how comprehensive his knowledge of Burmese birds is, how accurate his observations and how authentic his statements.

He says that North Burma is poor in birds, and I am bound to accept that. At certain seasons however, as he himself is willing to concede, there may be a flush of birds—though he appears sceptical of my procession. Though I am loath to withdraw my wager that there might be 50 species and/or varieties new to Burma in the far north, I feel now that it was a rash bet. Might I however suggest that some of them are likely to be found amongst the wrens, chats, warblers, fly-catchers, bulbuls, babblers and other small birds. He must not however expect me to name them—if I did, they would not be new!

On one point however I must disagree with Smythies. I am indeed rather surprised that a field naturalist of his calibre should think that birds, many of which eat seeds and are responsible for distributing plants in a variety of ways, are not the concern of the botanist. The fact that I am ignorant about them does not alter the fact that it is desirable to learn.

When Lord Cranbrook spent a season with me in the Adung Valley, I collected 30% of the birds myself and made some observations, though I never got any credit for this. Now I know why. I am a botanist. . . It was when Cranbrook and I were camped on the bank of the Adung at the last Tibetan village (6,000 feet) from February to May, that we made the bulk of our collection and I noted the 'vast procession of migratory birds'. The low level Rhododendrons were in bloom, I think Cranbrook would concur. We added several birds to the Burma list, though we could not have collected a tithe of those we saw,—nor skinned a tithe of those we might have collected. And this in one short season, in one small valley. Multiply our efforts by 10, by 20, and we might conceivably begin to approach my figure. As for the 'few passing kicks' which Smythies in lighter vein says that I handed out (can one hand out a kick?) to the *Birds of Burma,* these were aimed at the map only; and after all a friendly kick is not far removed from a kiss! I have spent many happy hours on some of the remoter rivers of Assam watching birds with the *Birds of Burma* open beside me. Unfortunately it was not mine and I returned it reluctantly to its trustful owner, having overcome a great temptation.

Smythies' has written me that his book may be republished. I sincerely hope this is true.

KHOWANG TEA ESTATE,
MORAN DISTRICT, F. KINGDON-WARD.
UPPER ASSAM.
16 *September* 1945.

16.—ON THE BREEDING OF THE TIGER SHARK (*GALEOCERDO TIGRINUS* MULLER & HENLE).

The systematics of the Tiger Shark *Galeocerdo tigrinus* was included by me in a previous paper published in this *Journal* (Vol. xliv, No. 1, 1943). The paper also contained an account of its feeding and breeding habits, based on the observations from such stages of pregnancy as were then available to me. Subsequently I conducted an autopsy on a female with young in her uteri, almost ready for expulsion. The condition observed is described below:—

Parturition stage:—

Parent female: total length 12′ 11″; app. wt. 1,500 lbs.; date 4-5-43.

Each uterus had 13 foetuses, 7 males and 19 females. They were enclosed in water-filled sacs and floated freely in them, there being no attachment to the uterine wall. The foetuses ranged from 2′ 3″ to 2′ 5½″ in total length. Their yoke-sacs and umblical cords were extremely reduced in size and length and showed conspicuous structural degeneration. There was no longer any yolk in the yolk-sacs, and their walls were extremely shrivelled up without any trace of blood capillaries. The reduced umblical cords measured from 2″ to 4″. The umblical vessels had atrophied and fibrosed. The umblical sheaths showed considerable rugosity and fibrosis near the points of attachments, suggesting that they would shortly be cast off. A dissection of the foetus revealed the presence of a large internal yolk-sac containing plenty of yellow yolk. All these features made it evident that parturition was near at hand. The mucous membrane of each of the uterine compartments (horizontally disposed) was plain and smooth but fairly vascular.

These observations clearly verify the inferences drawn by me in my aforesaid paper that,

1. The young of this species measure, at birth, about 2′ 6″ in length, and

2. That *G. tigrinus* is a non-placental form. The large quantity of yolk in the sac serves as nourishment for the embryo throughout its intra-uterine life, no placenta being at all formed.

DEPARTMENT OF FISHERIES,
BOMBAY, P. N. SARANGDHAR, M.SC., PH.D.
30th October 1945.

17.—A NOTE ON THE CONSERVATION OF OUR INLAND FISHERIES BY LEGISLATION.

An enquiry was made by Francis Day[1] in 1868-70 into Fresh water Fisheries of India and Burma showed that an indiscriminate and wholesale slaughter of fish life took place annually. Dr. Day pointed out that unless remedial measures were adopted this indiscriminate destruction of spawners and spawn would result in great diminution in the fish supply of India.

Legislation.—It was, however, in 1897 that protection to Fisheries in India was afforded by legislation with the enactment of Indian Fisheries Act IV. This Act, as Comber[2] (1906) pointed out was very far from being what all competent experts would have liked to see it. It prohibited the use of poisons and dynamite in rivers, but practically left everything else to local administrations to whom power was given to frame such minor rules, under the Act, as might seem necessary for the protection of fish in waters under their jurisdiction—by prohibiting or regulating (a) the erection and use of fixed engines, (b) the construction of weirs, and (c) the dimension and kind of nets to be used, and the modes of using them. No machinery was introduced for the proper working of the Act.

Provincial legislation.—Inquiries recently made show that in some provinces the Indian Fisheries Act has not been adopted at all, in others it is in force but no subsidiary rules have been drawn up. In Bengal, owing to Permanent Settlement, the fisheries position is very complicated. Some protection to fisheries in reserved and protected forests is afforded under the Forest Act. In respect of private waters, Private Fisheries Protection Act, II of 1899, passed by the Bengal Legislature penalises poaching in such waters. In Bombay, fishing in the rivers is entirely free and no rules have been framed for conservation of inland fisheries. The same applies to almost all other provinces in India. It is only in the Punjab that the fisheries are protected by Provincial legislation. The Punjab Fisheries Act II enacted in 1914. Its provisions are applicable to all the rivers, canals and other public waters. The Act and the Rules notified thereunder prohibit (1) all kind of fishing in rivers and canals except under a licence, (2) the use of small meshed nets and fixed engines, (3) sale of certain important species of fish caught in contravention of rules, and imposes (4) a close season for fishing during the breeding period of the fish.

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[1] Day, F. (1871)—'Report on the Fish and Fisheries of Fresh Waters of India and Burma. Simla. pp. 1-49.

[2] Comber, N. (1906—'Protective Legislation for Indian Fisheries'. Journ. Bomb. Nat. Hist. Soc. XVII, pp. 637-644.

Legislation, undoubtedly, prevents the depletion of the rivers by such harmful methods as small meshed nets, traps and fixed engines and thus helps in improving the fisheries. But the Indian Fisheries Act, IV of 1897, without any rules or without any machinery to work its provisions, is entirely inadequate to afford any substantial protection to the fisheries.

For the conservation of our existing fisheries, it is desired, that all Provincial Governments, where no rules or regulations for the protection of fisheries at present exist, may be advised to enact protective legislation and at the same time create an agency to work its provisions. The legislation should specially provide for the following:—

1. Control of all kinds of fishing under a licence.
2. Prohibition of small meshed nets, fixed engines, erection of dams and diversion of water for catching fish.
3. Imposition of a size limit below which no fish of such important species as Mahsir (*Barbus tor*), and others can be killed.
4. Provision of a close season during the breeding period of fish.
5. Prohibition of the sale of certain important species of fish caught in contravention of rules.

LAHORE, HAMID KHAN, PH.D. (Cantab), F.A.SC.,
7th July 1944. *Game Warden*, Punjab.

18.—ECOLOGICAL AND SPECIFIC VARIATION IN THE CAMOUFLAGE DEVICES OF SPIDER WEBS.

I am at present collecting records of orb webs with camouflage devices. Such spiders as the members of the Genus, *Argiope, Uloboridae* and *Cyclosa* are common through the tropics.

Hingston in his paper Devices of Spiders' snares (*P.Z.S.* 1927 Vol. xviii) gives an outline of the more common web designs, which is useful for reference.

The preparation of webs is quite easy. A sheet of white paper is covered with any good dilute gum, and then placed close to the web. The supports are then broken and the web and paper dried.

I process these webs with water colour to make the webs stand out.

The webs should be accompanied by the spider, in a small paper packet, and with notes on—

1. Where collected.
2. Whether grassy, or shrub ground, or in house, etc.
3. Some indication as to whether the web is exposed to direct sunlight and the amount of illumination.

The webs should be sent to my home address, as my army address is not very permanent. My address is as follows:—

35, HIGH PARK DRIVE,
HEUTON, BRADFORD,
YORKS, ENGLAND.

Any webs which you may send will be very acceptable and will help considerably in increasing the extent of my records.

S.E.A.C., J. E. MARSON, F.R.E.S.
11th October 1945.

19.—NOTES ON THE GIANT WOOD SPIDER (*NEPHILA MACULATA*) IN BURMA.

(*With 2 plates*).

Nephila maculata is very widely distributed in Burma. My own records for 1945 give the distribution as follows: 3-2-45 Maungdaw; 23-2-45 Ramree Island; 27-5-45 Taungup; 7-9-45 mile 35 Toungoo Mawchii Road; 14-9-45 mile 53 Toungoo Mawchii Road; 1-10-45 Mawchii.

The structure and method of spinning the web is very well described in Hingston's paper 'The Snare of the Giant Wood Spider'.[1] I would however like to add the following notes on the web.

It is very common to find that the female *Nephila* uses a maze of irregular webbing at one or both sides of the large orb web. Hingston comments on this point as follows[2]: 'There is another structure in the architecture of the *Nephila* which I have not observed in ordinary snares. Not only does she spread an extensive sheet, but she also constructs a special barrier in order to drive her victim more surely into the toils. She places it so as to face one surface of the sheet, it is at a slightly higher level than the main snare and a little distance away. There is nothing precise or geometrical in its workmanship, it is merely a tangled maze of lines.'

This addition of an irregular maze of webbing at one or both sides of an orb web is not uncommon amongst orb-web spinners, especially in the case of immature females, and with webs in shaded places. This is quite common with species of *Gasterocantha*, especially with *G. brevispina*. In these cases it is usual for the maze webbing to be dotted with patches of white webbing about a quarter of an inch long.

The structure of which Hingston says[3] 'she places it so as to face one surface of the sheet, it is at a slightly higher level than the main snare and a little distance from it,' is typical of the web of an adult female in a position where there is a fair amount of both room and light, *e.g.* between trees in fairly open woodlands. I found *N. maculata* amongst the well laid-out rubber plantations in Ceylon. This was the first time that I had met the species, and I cannot remember ever seeing any additional irregular webbing in these perfect conditions for spinning the large orb web. It is therefore probable that this irregular webbing is only added by an adult female when there are shrubs surrounding the web. The upper edge of this sheet of irregular webbing is attached to the upper supports of the orb web, the lower edge being attached slightly in front of the lower supports, giving a sheet of irregular webbing at an angle to the orb web.

---

[1] Hingston.—The Snare of Giant Wood Spider; *Journal of the Bombay Nat. Hist. Society*: Part I Volume xxxviii pages 642-649; Parts II & III Vol. xxviii pages 911-923; Part IV Volume xxix pages 70-75.

[2] As above.—Part III page 918, lines 18-31.

[3] As above.—Part III page 918, lines 21-22.

It is very common to find wide variations from this form even in webs of adult females. When webs are spun in semi enclosed conditions, the addition of irregular webbing at both sides of the orb web is common, giving a much more impressive structure than that of the simple orb web. From a side view the web has the appearance of a spindle. In these cases the sheets of irregular webbing are supported at their centres giving a dome of irregular webbing, as illustrated by the heavy dotted line in Fig. 1, plate 1.

The following figures from a web of this type, spun in a rather limited space, will indicate the size of this additional webbing.

H 110 cms. A_1 25 cms. A_2 45 cms. B_1 20 cms. B_2 40 cms.

The actual form this webbing is very irregular as can be seen in Plate II where the irregular webbing has been superimposed upon the orb web as seen from a front view. These illustrations were drawn from webs prepared after the whole web had been completed for three days.

The completest form of this irregular webbing is however best seen in the young stages of the female. I have never found the younger stages without an irregular web at both sides of the orb web. Often these are large as compared with the height of the orb web supports, the complete width of the spindle being equal to the height of these supports.

Abdomen Length	Orb Web Height 'H'	Measurements of Spindle				
		A_1	A_2	B_1	B_2	$A_2 + B_2$
1·1 cms.	50 cms.	10 cms.	20 cms.	7 cms.	25 cms.	45 cms.
1·1 ,,	50 ,,	12 ,,	28 ,,	9 ,,	25 ,,	53 ,,
1·2 ,,	45 ,,	13 ,,	20 ,,	...	8 ,,	21 ,,
1·4 ,,	75 ,,	18 ,,	40 ,,	...	15 ,,	33 ,,
1·6 ,,	80 ,,	15 ,,	25 ,,	...	10 ,,	25 ,,

PLATE I

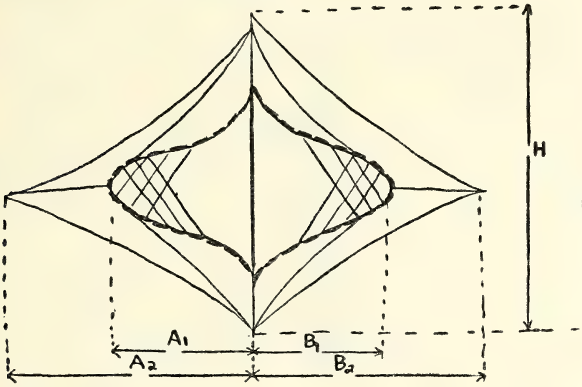


FIG 1

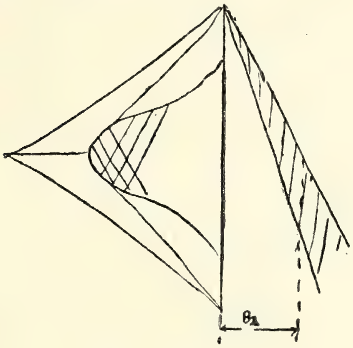
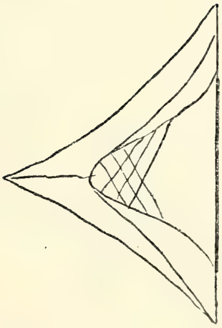


FIG 2



NEPHILA
MACULATA
WEB TYPES.

FIG 3

TEM 21.11.45.

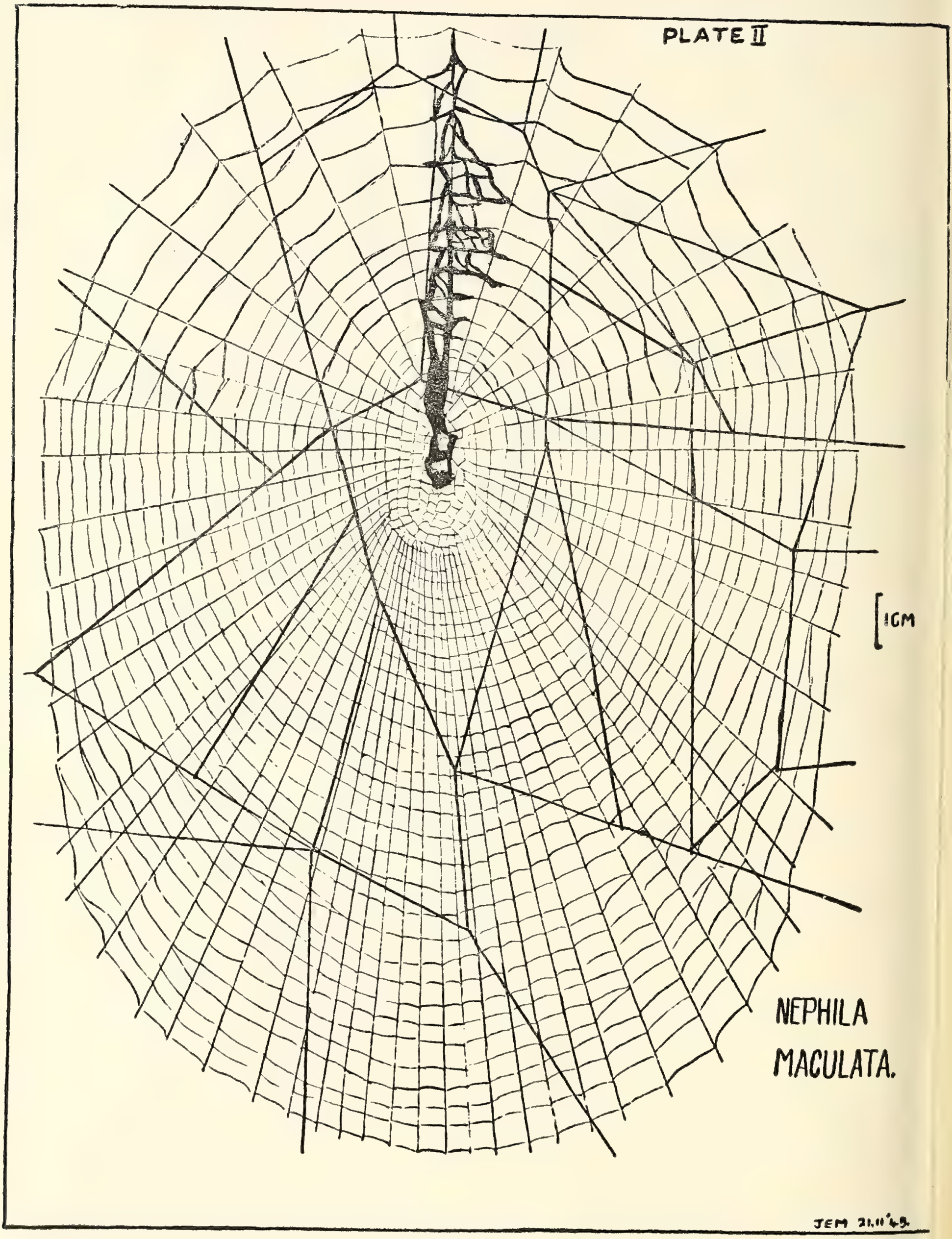


PLATE II

NEPHILA MACULATA.

1CM
JEM 21.11'49.

With older stages, it is usual to find an irregular cone web at the most shaded side, and the orb web and a sloping sheet of angular webbing at the other side. In this cone the width of the additional webbing is about half the height of the orb web, Fig. 2, Plate I. Webs of almost mature females usually have the irregular webbing at one side, the shaded side of the orb web, Fig. 3, Plate I.

I have only recently started recording measurements of these webs but the first set of measurements indicate that the extent of this additional irregular webbing is determined by the maturity of the female and the intensity of illumination.

It is common to find immature male spiders in the webs of immature females, but in this case they are always found resting in the irregular webbing. They only move to the side of the female's orb web when they both reach maturity.

It is quite common to find that insects have become entangled in the irregular webbing and have not been touched by the female; so it is probable that the use of this maze of webbing is to prevent the spider being plucked from its web by animals which prey on the younger stages. Only insects caught in the central orb are used as food.

In webs of immature females, a vertical line of heavy white webbing about three-eighth of an inch wide and half the height of the orb web is often introduced. This has a camouflage effect similar to the confusion effect of the concrete zigzag of *Argiope*[1]. At times this line of heavy webbing is also present in the adult female's web, Plate II. The webbing of the immature female is white but that of adult is yellow. There is no form in the arrangement of this additional webbing and it may be composed of the remains of parts of the web, which the female has broken down and failed to digest[2]. With this additional webbing being yellow in colour, the abdomen of the female merges with it, the large spider's outline being very confused.

MAWCHII, BURMA, J. E. MARSON,
30th November 1945. F.R.E.S.

20.—THE BUTTERFLIES OF THE NILGIRIS— A SUPPLEMENTARY NOTE.

I should like to make one or two comments on Mr. Wynter-Blyth's excellent article, 'The Butterflies of the Nilgiris, Part I', published in Vol. xliv, No. 4 of the *Journal.*

---

[1] As above.—Part III pages 918-919, lines 50-51, 1-50.

[2] Hingston.—Devices in Spider's Snares; P.Z.S. 1921, Vol. xviii, pages 283-285.

1. *Pathysa antiphates naira*, M. In Vol. xxxviii, No. 4, Brigadier T. E. Delves Broughton reported that he had in his collection two specimens, taken on the Nadghani Ghat Road on 23-4-1921. The butterfly can definitely be included in the Nilgiri list.

2. *Prioneris sita*, Fd. The British Museum has this butterfly from the Nilgiris, from Crowley's collection (*Vide* my list in the *Journal*, Vol. xxxviii, No. 2).

3. *Discophora lepida lepida*, M. This is listed by Hampson: 'one female seen on the Western Slopes in October 1888 at 300 feet'.

4. *Euthalia nais*, Forester., *Euthalia lepida miyana*, Fruh., *Euthalia garuda meridionalis*, Fruh., *Euthalia lubentina arasada*, Fruh., *Euthalia evelina laudabilis*, Swin:—All five, not merely *nais*, are recorded by Hampson as Nos. 71-75 in his list of 1888. Of *nais* he says, 'In bamboo jungles'. Of the other four he says, 'Rare', and of *evelina*, 'Rare and difficult to catch'. He records the heights between which he took them.

By a slip of the pen Mr. Wynter-Blyth says, '*evelina* and *garuda* seem to be common round Bangalore.' I never heard of *evelina* being caught or seen round Bangalore; perhaps my information is incomplete. It certainly is not common in that neighbourhood, if at all it exists. '*Evelina*' is, I think, wholly an evergreen forest butterfly. The two species common round Bangalore are *nais* and *garuda;* the latter is very common among the mango trees.

5. *Doleschallia bisaltide malabarica*, Fruh., has been taken in the Nilgiris. The record of one taken by Stokes Roberts was given me by the British Museum; whereabouts, I do not know. (*Vide* my list in Vol. xxxviii, No. 2 of the *Journal*.)

CRANHAM,
BERKHAMSTED, J. A. YATES.
16th December 1944.

21.—NOTE ON THE BUTTERFLY, *MELANITIS PHEDIMA VARAHA*.

Mr. Wynter-Blyth's note on this insect, in Vol. xliv, No. 4 of the *Journal* has induced me to offer a few observations.

(1) This butterfly is common in Coorg. It appears to favour the evergreen area or the mixed evergreen and deciduous areas. And, as evergreen and mixed forest or woodland, cover the greater part of the province, it is almost ubiquitous. Specimens in my collection—a selection of catches—range in altitude from the foot of the Ghats upwards, and in extent from Urti in the south to Somwarpet in the north, *i.e.* from 300 feet above sea level to 3,700 feet.

(2) The dry season forms appear, it would seem, early in November and persist until early May. As to the wet season forms, I find that I took them September-October. I was never in Coorg during the heavy monsoon months, June to August; I think it very probable that the wet season forms last from June to October. My collection covers the months September to May.

(3) D.S.F. are generally quite a bit larger than W.S.F.

(4) W.S.F. ♂ ♂ *Above* dark. *f.w.* not produced, and termen not angled, or only vestigially angled. Black spots not visible; and no white spots on *f.w.* or *h.w.*

Underside, as described by Evans. 'Ocelli small, but more or less complete and usually well formed. (This applies also to ♀ ♀).' But there is great variation. In some specimens the ocelli are very small; white centre hardly visible. Or, the *h.w.* ocelli are clear but *f.w.* Ocelli faint. The discal line, however, is generally clear.

W.S.F. ♀ ♀. Lighter in colour, brown not blackish. *f.w.* slightly produced and angled. 'Tail' at v. 3 *h.w.* slightly longer than that of ♂ W.S.F. White spots variable, 2, 1 or 0.

(5) D.S.F. ♂ ♂. *Above* dark brown, ashy on margin. Sometimes on *f.w.* angle and *h.w.* 'tail' slightly ferruginous. Dark spots on *f.w.* visible, but not prominent. White spots *f.w.* generally present, 1 or 2, but occasionally 0. Sometimes minute white spot on *h.w.* near v. 2 towards margin.

D.S.F. ♀ ♀. Above *f.w.* more produced and angled than W.S.F. Spots on *f.w.* variable as in W.S.F. *h.w.* 'tail' v. 3 longer than in W.S.F.

Underside.

D.S.F. ♂ ♂. Very variable, commonly purplish brown. Discal line, prominent or vague. Ocelli as a rule faint or vestigial or mere dark spots. Occasionally, though not clearly ringed, a full range of light spots.

D.S.F. ♀ ♀. Generally ferruginous, sometimes of a rich umber tint. Discal line obvious, but perhaps not so defined as in W.S.F. Ocelli very variable; seldom ringed. Thus they may be just black dots, or vague yellowish spots not defined by a line.

GRANHAM, J. A. YATES.
BERKHAMSTED,
16*th December* 1944.

22.—STALKED COCOONS.

With reference to Mr. Loke's note (1945, *Journ. Bomb. Nat. Hist. Soc.*, 45 : 440) on the cocoon of the Tussar Silk Moth, the pedunculate cocoon of *Antheraea paphia* L. is quite normal. In addition to this species, a number of Saturniids spin pedunculate cocoons.

Whilst I have never found any of these cocoons *in situ,* both from literature, and from the cocoons of *paphia* and *Leopa newara* Moore that have been given me by friends, I have always understood that they were normally suspended by the stalk alone and had no other support.

Moore (*Lep. Ceyl.,* ii) under his diagnosis of the family Saturniidae, writes 'Cocoon . . . . attached to a twig by a silken peduncle, or to pendent leaves by silken threads.' Under *Antheraea cingalesa* Moore, now often considered a sub-species of *Mylitta* Drury, he states 'Cocoon . . . attached to twig by a short coarse silken peduncle', and the figure shews the cocoon standing out almost at right angles to its support. Under *Attacus taprobanis* Moore, now considered a subspecies of *atlas L.,* we find 'Cocoon. . attached to a twig by a silken peduncle amongst the leaves', but the figure does not shew the cocoon *in situ.*

Hampson (*Fauna Brit. Ind.,* Moths, i) under *Antheraea paphia* L., *A. knyvetti* Hamps. and *Loepa newara* Moore states 'Cocoon pedunculate' without giving further details.

Seitz (*Macro-Lepidoptera of the World,* x) writes under *Samia,* 'the cocoon often enveloped in leaves, . . . it is often suspended by a long strong silk cord', and under *Antheraeu,* 'Cocoons of *paphia* and *mylitta* shaped like a nut suspended on a long silk thread . . . .'

No cocoon of either *paphia* or *newara* that I have seen has shewn any sign of attachment to a leaf, and none has had the vein marks that are so clearly shewn on the cocoon of *Samia cynthia* Drury, when it is spun in a leaf. The attachment of Mr. Loke's cocoon to a leaf was, I think, rather exceptional.

The explanation given for the stalked condition of these cocoons is not merely that of attachment. It is usually considered to be a protection from the attacks of birds, the cocoon merely swinging away on its stalk when pecked at, instead of being torn open as the normally fixed cocoon would be.

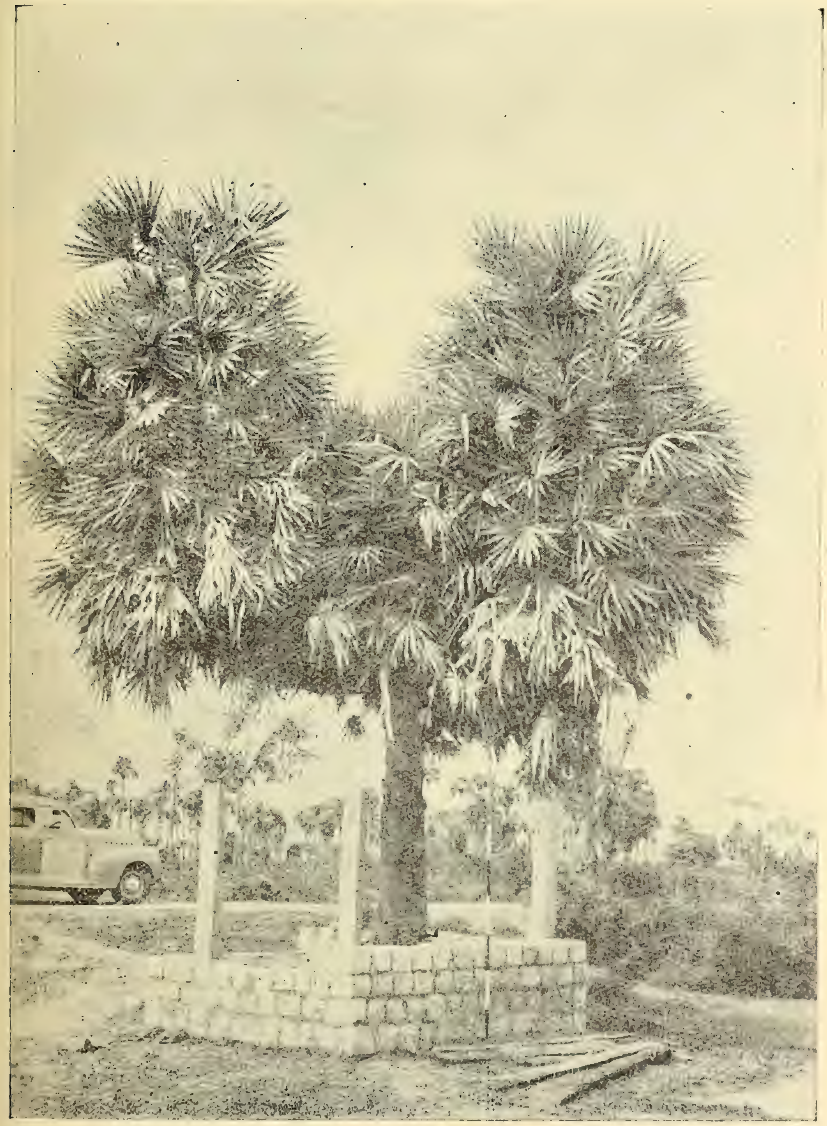
Samia cynthia Drury normally spins a non-peduncultae cocoon among leaves or along a twig, but sometimes the cocoon is spun inside a single leaf, and the stalk of the leaf is spun over with a layer of silk and fixed firmly to the twig thereby, which prevents the leaf falling. This is, I believe, considered a racial characteristic.

The stalk of the cocoon of *A. paphia* is, of course, pure silk, the individual threads being spun side by side and fusing to form a solid cord.

CALCUTTA, D. G. SEVASTOPULO, F.R.E.S.
19*th November* 1945.

23.—INSTANCE OF FASCIATION IN PALMYRA (*BORASSUS FLABELLIFER*)

(*With a photo*)



A Fasciated Palmyra Palm.

I am enclosing a photograph of a fasciated Palmyra growing on the side of the Pudukkottai-Ponnamaravaty Road (Road No. 18) in the Pudukkottai State, at mile 9/2 near the Sittur village.

The Palmyra has 12 branches and the main stem is about 12 feet high—cf. the painted 6 foot pole in the photograph placed near the tree. Since the tree has not been observed in flower, I am not able to say whether it is male or female.

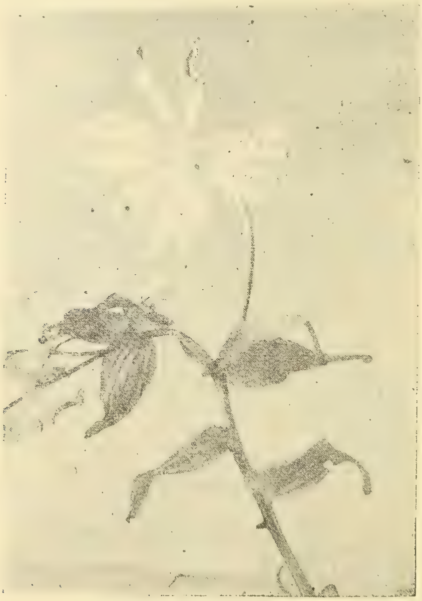
The local people have erected a platform round it and worship the tree as the abode of a popular local deity 'Porpanaiyan' who is associated in local legend with the 'golden palmyra'.

This note and the photograph if published will I hope interest your readers.

STATE MUSEUM, K. R. SRINIVASAN, M.A.,
PUDUKKOTTAI (S. INDIA). *Curator.*
14th November 1945.

24.—AN ABNORMAL FLOWER OF *GLORIOSA SUPERBA* LINN.

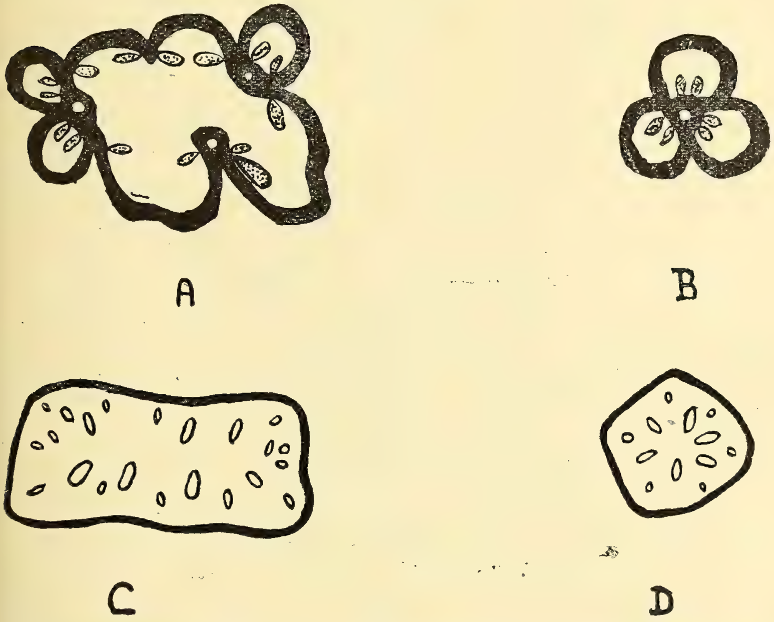
Towards the end of the rainy season Mr. Prater, the Curator of the Society, sent me an abnormal flower of *Gloriosa superba* Linn, which had been collected by Mrs. Waber, a member of the Society.



Gloriosa superba. Linn.

The abnormality of the flower is at once apparent in the accompanying photograph and diagrams. There were in all six flowers on the one branch sent to me; five of these flowers were normal, one was very abnormal.

The perianth of this abnormal flower consisted of 13 segments, each of them regular in colour and structure; stamens were also 13, and the anthers and filaments were entirely normal. The ovary was a very striking structure, obviously the result of the fusion of 2 or 3 ovaries. For the sake of comparison I append a diagram of a normal ovary side by side with the ovary of the abnormal flower. In the latter there were externally 9 lobes; on dissecting the ovary, however, it was found that there were only seven lobes, two of them being much more developed than the rest; the placentation of the abnormal flower was of the usual parietal type, with a double row of ovules along each of the sutures. At the apex of the ovary there were two styles, each with three stigmas or stigmatic lobes.



Gloriosa superba. Linn. A-B: T.S. of abnormal (A) and normal (B) ovary (× 6). C-D: T.S. of abnormal (C) and normal (D) flower stalk (× 8).

Dissection of the stalks of the normal and abnormal flowers showed a great difference between the two types of flowers. The normal flower stalk is roughly quadrangular in transverse section; that of the abnormal flower was rectangular and about as thick as the normal stalk, but 2½ times as broad. The number of vascular bundles in the regular stalk are 6+6, arranged in two concentric circles; in the irregular stalk there were 23 bundles arranged in a very irregular fashion.

The numbers of the various parts of the flower at once suggest that the abnormality was the result of the fusion of 2 or more probably 3 flowers. The fact that the segments of the flower were not multiples of 6, seems to indicate that there were three flowers fused in such a fashion that some of the segments had been suppressed or lost in the fusing process.

St. Xavier's College, Bombay. H. SANTAPAU, S.J.
5th December 1945.

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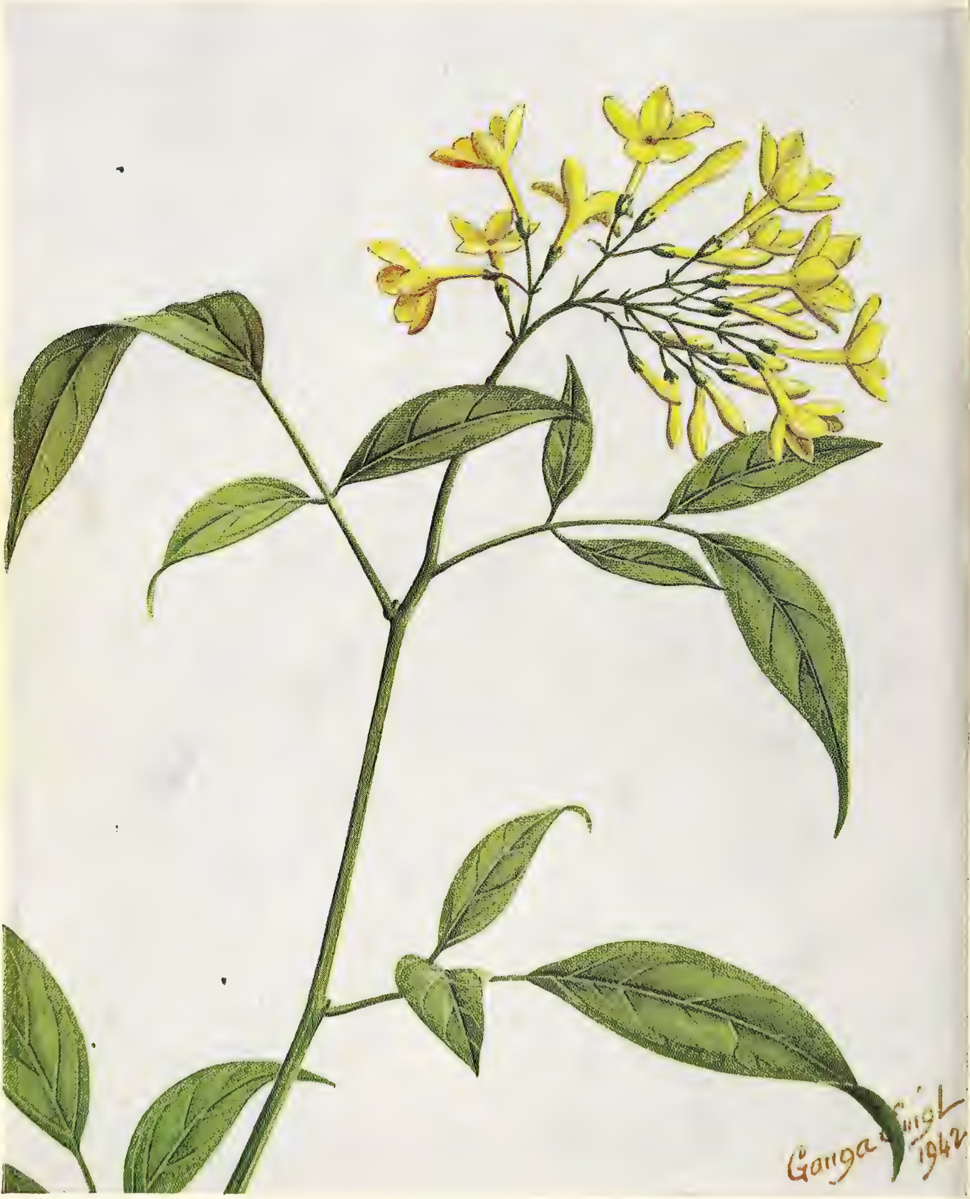
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EDITORS

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1946. VOL. 46. NO. 2.

SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.

BY

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PART XXIII.

(*Continued from Vol.* 46, *No.* 1, 1946, p. 12.)

(*With* 1 *coloured and* 4 *black and white plates and* 7 *text-figures.*)

Oleaceae.

The Olive Family.

This family takes its name from one of its genera, *Olea*. *Olea* is itself derived from the Greek word, *elaia*, a name for the Olive. Olive oil was called *elaion* in Greek.

Oleaceae is a large family of 22 genera and about 400 species, distributed throughout the temperate and warmer regions of the earth. Included in the family are deciduous and evergreen trees and shrubs with opposite leaves. The leaves are simple or compound exstipulate. Inflorescence various, axillary or terminal; flowers hermaphrodite, rarely unisexual, regular. Calyx nearly always present, small, 4 or occasionally more-lobed, usually bell-shaped. Corolla gamopetalous, sometimes of four petals, often 4-lobed. Stamens 2; anthers apiculate, often back to back, opening lengthwise; filaments short. Ovary superior, 2-celled; ovules usually 2 in each cell. Fruit a capsule, berry or drupe.

The flowers of the species of *Oleaceae* are often sweetly scented and numbers of them secrete a nectar at the base of the corolla, characteristics which indicate fertilisation through the agency of insects. An interesting fact about some species, e.g. *Nyctanthes arbor-tristis* (the well-known *Harsingar*) and various species of *Jasminum,* etc. is that their flowers are fragrant after sunset. In these cases nocturnal *Lepidoptera* act as the unconscious agents of cross-fertilisation. In certain cases, however, for example in the ash, *Fraxinus,* where there is no corolla, the blossoms are pollinated by the wind.

The fruits of the ash are winged but a good many species depend upon an edible fruit for the distribution of their seeds.

One species, the olive tree, is of importance economically. In all countries surrounding the Mediterranean the tree, *Olea europaea* Linn. is cultivated for its fruit. The well-known olive oil may be pressed out of the fruits, which are also used for pickling. Its original home is in Asia Minor but it has been introduced with great success into California. Efforts have been made in the past to introduce this tree into India but with little success so far, though reports from Kashmir are encouraging. In India the tree does not bloom in which case there is no fruit, or if it does bloom, the fruits drop off before they are ripe. It may, however, be possible to achieve success by grafting the European olive on to one of the indigenous olives.

The largest genus in the family is *Jasminum,* of which a large number of species occur in India. The genus is well represented in our gardens and is valued for its pretty sweet-scented flowers and glossy foliage. *Syringa* and *Ligustrum* are sometimes grown in the hills. *Syringa vulgaris* Linn. is the well-known common Lilac of England.

KEY TO THE GENERA.

Leaves simple or compound; if simple articulated on the petiole.	1. *Jasminum.*
Leaves simple, continuous with the petiole.	2. *Osmanthus.*

Jasminum Linn.

The Jessamin, Jasmin or Jasmine.

(This generic name is said to be derived from *ysmym,* an Arabic word. There is, however, no certainty about this and others derive it from two Greek words, i.e. flower, and *osme,* scent).

An important genus of shrubby or climbing plants, comprising about 200 species. Many of these are cultivated in the open in the warmer, and under glass in the colder regions of the world, not only for their pretty flowers and handsome foliage but also for the delicate perfume of the blooms. Leaves simple, 3-foliate or odd-pinnate; petioles articulated. Inflorescence usually, rarely axillary, cymose; flowers bracteate, hermaphrodite yellow, red or white in colour. Calyx usually bell-shape, sometimes cylindrical with 4-9 lobes. Corolla-tube slender, 4-10 lobed; lobes spreading, Stamens 2, included within the tube on short filaments. Anthers oblong; connective shortly produced. Ovary 2-celled; ovules 2 in each cell, basal, erect; style slender; stigma linear. Fruit a berry.

The well known perfume, Jasmine, is extracted from the flowers by the process known as 'enfleurage', first developed in France. The flowers are lightly spread over a layer of solid fat. Every 24 hours or so the old flowers are replaced by fresh ones so that the fat eventually becomes saturated with the sweet smelling substances. These are subsequently extracted with the aid of alcohol, acetone and other solvents. Another method in use in France to extract the perfume is to spread the flowers on blankets which have been soaked in olive oil, from which it is recovered in the usual way. The principal ingredient of the perfume is a pale yellow oil with small quantities of benzoyl acetate, benzul alcohol, indole and certain esters. The trade in jasmine oil is very large. In France alone, about 600 tons of flowers are used for this purpose and to this must be added further large quantities produced in Tunis, Algeria and in other countries of the world. Some of the species, used as medicine, bear a high reputation for the treatment of various diseases. The medicinal uses of the various plants will be outlined under the species about to be described.

KEY TO THE SPECIES.

Leaves opposite.	
Leaves 1-foliate.	
Calyx-lobes short, plant hairy.	*J. sambac.*
Calyx-lobes very long; plant very hairy.	*J. pubescens.*
Leaves 3- or more-foliate.	
Flowers white.	
Terminal leaflets much larger than the others, distal pair not with broad connate bases; leaflets 3-7, lateral acute.	*J. officinale.*
Terminal leaflets not or scarcely larger than the others; distal pair with broad connate bases; leaflets 7-11, lateral usually very obtuse.	*J. grandiflorum.*
Flowers yellow.	*J. primulinum.*
Leaves alternate; flowers yellow.	*J. humile.*

Jasminum sambac Ait.

The Arabian Jasmine.

(*Sambac* is the Arabic name for the shrub, *zambak* in Persian).

Description.—A scandent or suberect shrub with pubescent branches. Leaves opposite, exstipulate, petiolate, ovate in shape, 1.5-3.5 in. long by .8-2.5 in. wide, thin, glabrous, obtuse, acute or acuminate at the apex, rounded at the base; lateral nerves 4-6 pairs, prominent beneath and looping within the margin; petioles .2 in. long, pubescent.

Inflorescence in few-flowered terminal cymes or occasionally, of solitary flowers. Flowers white, fragrant, pedicellate or not. Bracts linear-subulate, hairy. Calyx-tube campanulate, tubular, .5 in. long, 5-9 toothed; teeth linear-subulate, longer than the tube. Corolla-tube cylindrical, 1 in. long, 5-9 lobed; lobes acute or obtuse, as long as the tube. Stamens 2, included; filaments short. Ovary 2-celled. Fruit of 1-2 globose berries, each .5 in. in diameter, black, surrounded by the erect, persistent calyx teeth.

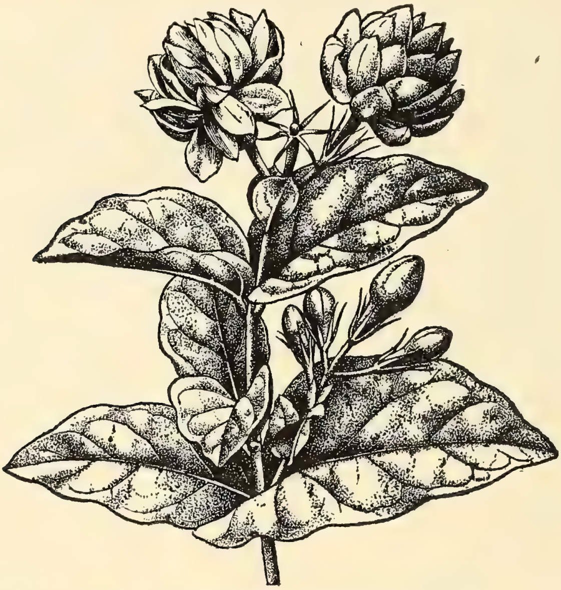

Fig. 1.—*Jasminum sambac* Ait. ×¾.

Flowers.—Hot and rainy season. Does not set fruit in this country.

Distribution.—Believed to be indigenous to South India, much cultivated in the tropics.

Gardening.—A straggling shrub much prized for its exquisitely fragrant flowers. The white, sweet scented flowers are considered sacred to Vishnu and are largely used by the Hindus for making into garlands. In the tropics the plant is almost invariably attacked by scale insects, usually resulting in a black fungus growth on the leaves. The shrub is consequently best alloted a place in the back ground in an unfrequented spot. The plant prefers a dry location and water must be applied to the roots and not on the leaves and blossoms. When, however, water touches the flowers they usually become blasted, turn black and fall. It flowers best and most profusely when grown in direct sun. Stripping off the leaves is a method commonly used to induce more blossoms. Propagation is by cuttings. It is commonly known by the name of Bela, Motiya or Mogra and has been under cultivation since very early times.

Economic and medicinal uses.—This plant has been cultivated since very early times. Double-flowered races are common. The flowers are used to give an aroma to Chinese teas. The perfume is extracted in India by the method known as enfleurage, but instead of fat or oil, crushed seasamum seeds are used. The leaves are

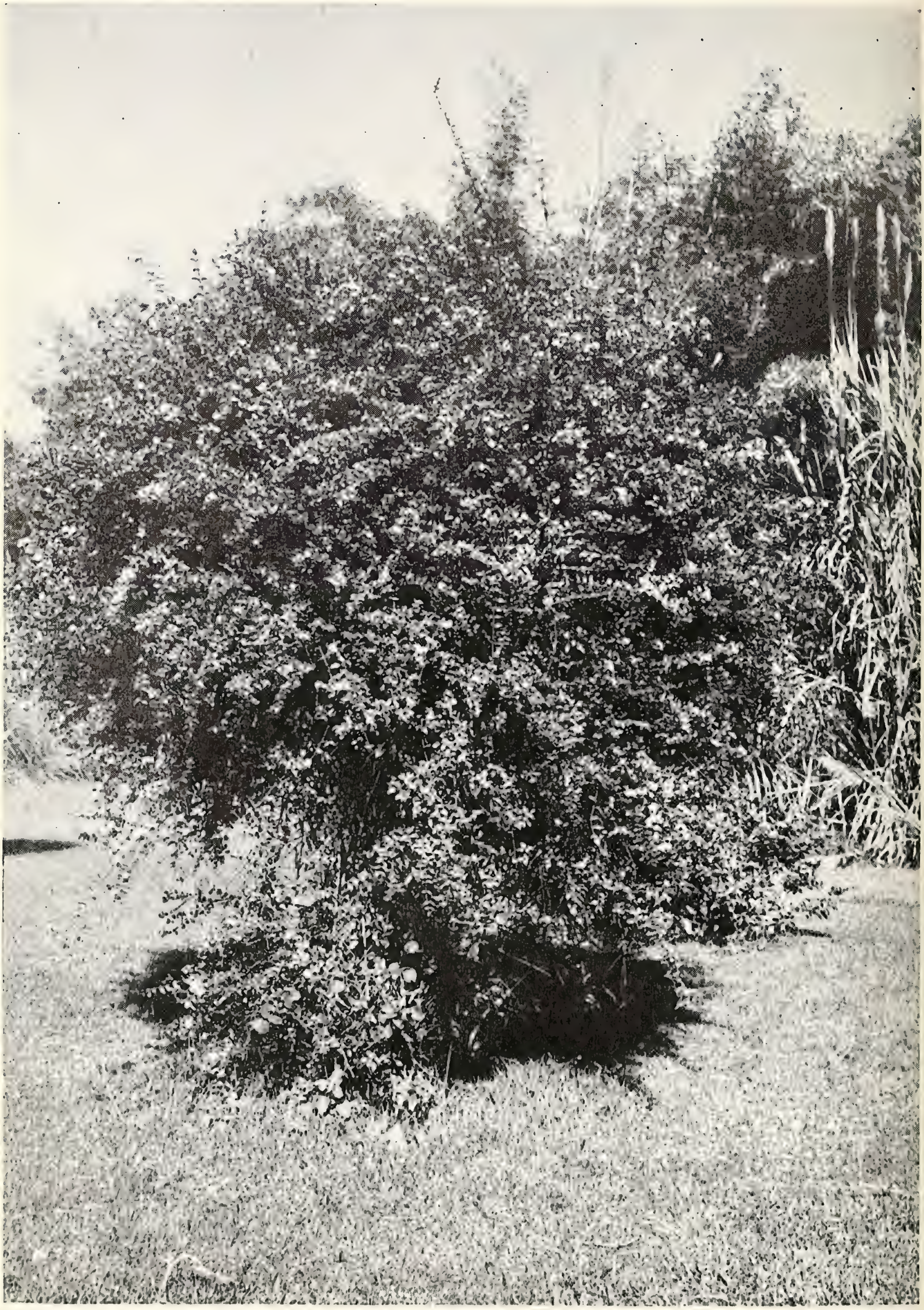

Photo by N. L. BOR

Jasminum pubescens, Willd.
New Forest, Dehra Dun

used in India as a lactifuge, and are said to be at least as efficacious as belladonna. A decoction of the leaves and root is used for sore eyes.

Jasminum pubescens Willd.

(*Pubescens* means hairy in Latin).

Description.—A scandent shrub; young parts velvety—tomentose, often rusty. Leaves opposite, simple, entire, petioled, exstipulate, ovate in shape, 1-3 in. long up to 1.5 in. wide, acute or acuminate at the tip, rounded or cordate at the base, upper surface pubescent becoming glabrous, under surface tomentose or pubescent, especially on the nerves; petiole stout, .2-.4 in. long, densely tomentose.

Inflorescence of dense capitate cymes, terminal at the tips of dwarf lateral branches. Flowers white, fragrant, .7-1.5 in. across, sessile or nearly so. Calyx-tube .5-.6 in. long, densely rusty tomentose, 6-9 toothed; teeth subulate, twice as long as the tube or more. Corolla-tube .7-.8 in. long, slender, 6-9-lobed; lobes oblong-lanceolate, acute, shorter than the tube; stamens 2, included. Ovary 2-celled; ovules 2 in each cell. Style slender. Fruit ellipsoid, about 5 in. long, black when ripe, surrounded by the long hairy calyx-teeth.

Flowers.—December-April and also during the rains. Fruits May-July.

Distribution.—Throughout the greater part of India ascending to 4,000 ft. in the Himalayas, also in Burma and China.

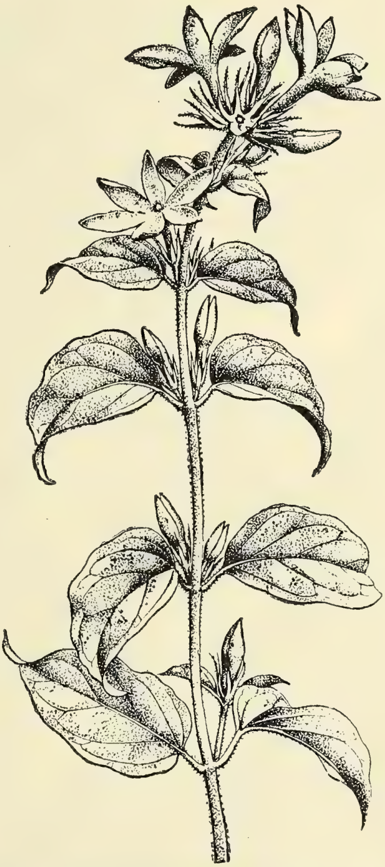

Fig. 2.—*Jasminum pubescens* Willd. ×¾.

Gardening.—A scandent shrub with all parts covered with pubescence. The star-like slightly scented flowers appear practically throughout the year and make this plant one of the most successful of landscape materials, either climbing on a trellis or as a ground cover and low shrub. It is not particular as to soil and sun requirements.

Medicinal uses.—A decoction of the root has some repute as an antidote to cobra venom, and that of the leaves is said to be of use in stimulating static ulcers.

Jasminum primulinum Hemsley.

(*Primulinum* means primrose-like in Latin).

Description.—An evergreen twiggy shrub with 4-angled, glabrous, stiff branches. Leaves opposite, 3-foliate, exstipulate, petiolate, up to 4 in. long. Leaflets almost sessile or with a petiolule up to .1 in. long, glabrous, narrowly elliptic or oblong-lanceolate, entire, 1-2 in. long, rather thick in texture, apiculate, wedge shaped at the base, dark green and shining above, paler beneath.

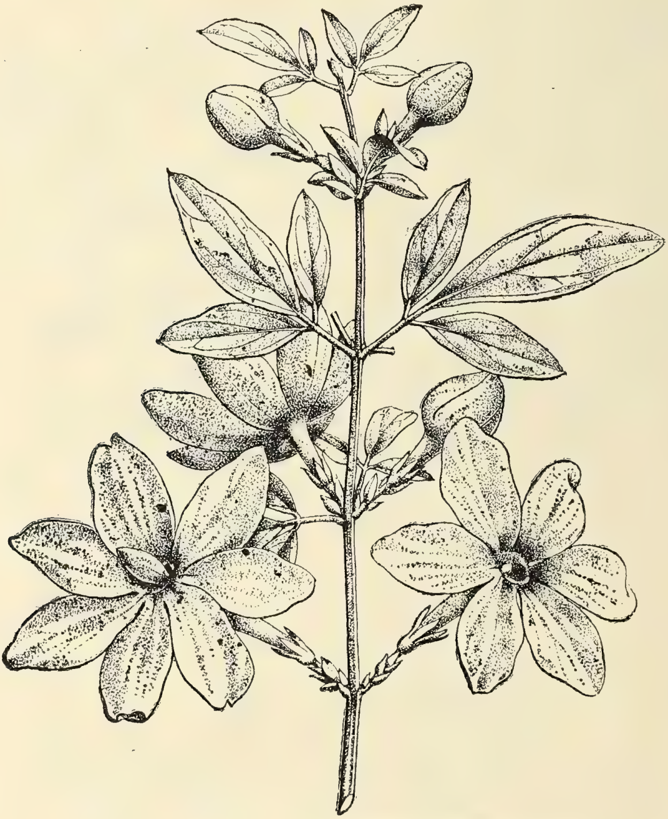

Fig. 3.—*Jasminum primulinum* Hemsley. $\times\frac{3}{4}$.

Flowers solitary on axillary peduncles, primrose yellow in colour, orange in the throat; bracts and bracteoles foliaceous often scale-like. Calyx bowl-shaped, .1 in. long, 6-lobed; lobes lanceolate, sparsely pubescent, .2 in. long. Corolla-tube stout, increasing slightly in diameter towards the top, usually 6-lobed; lobes obovate; rounded about 1 in. long.

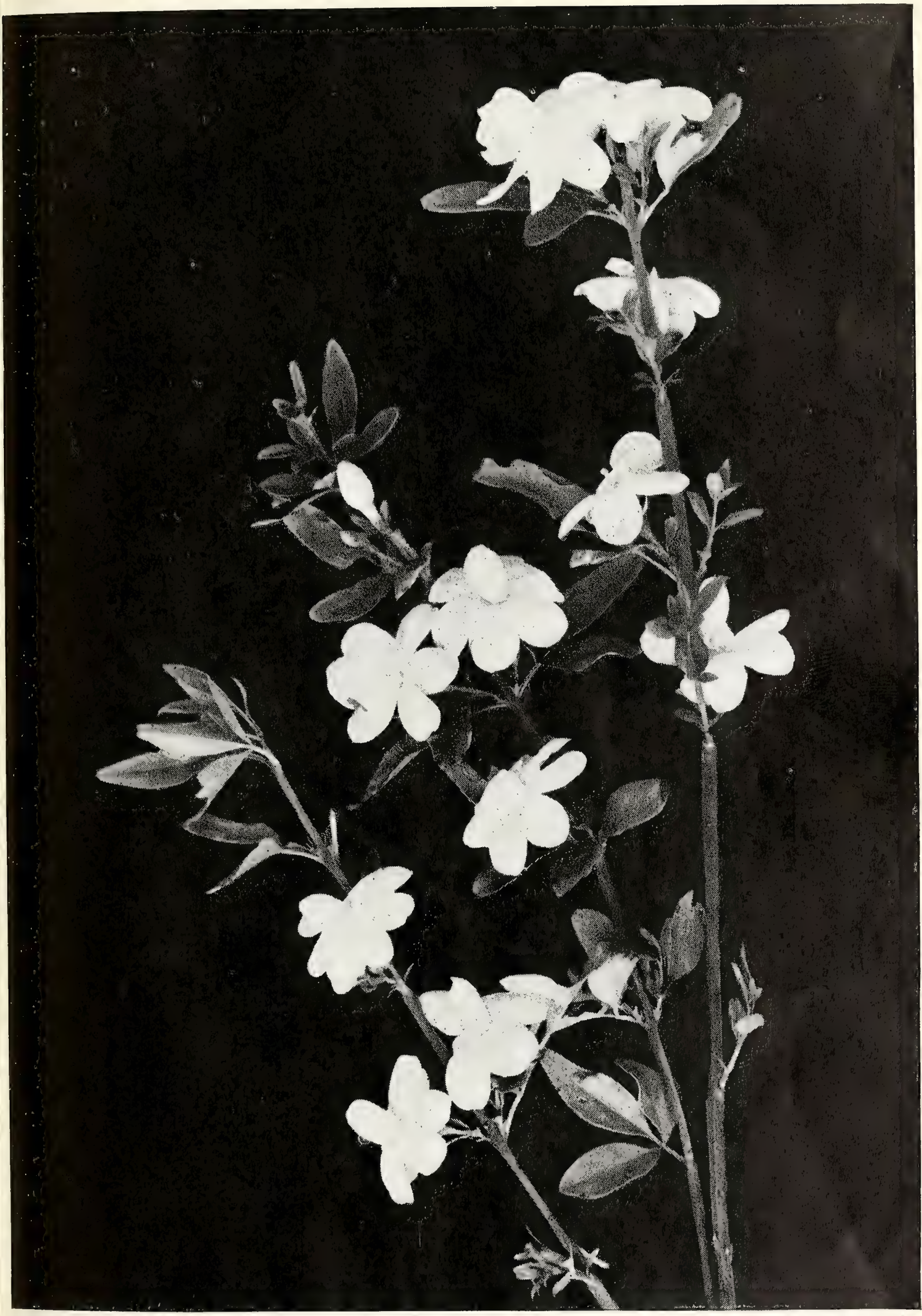

Photo by M. N. Bakshi

Jasminum primulinum, Hemsley
New Forest, Dehra Dun

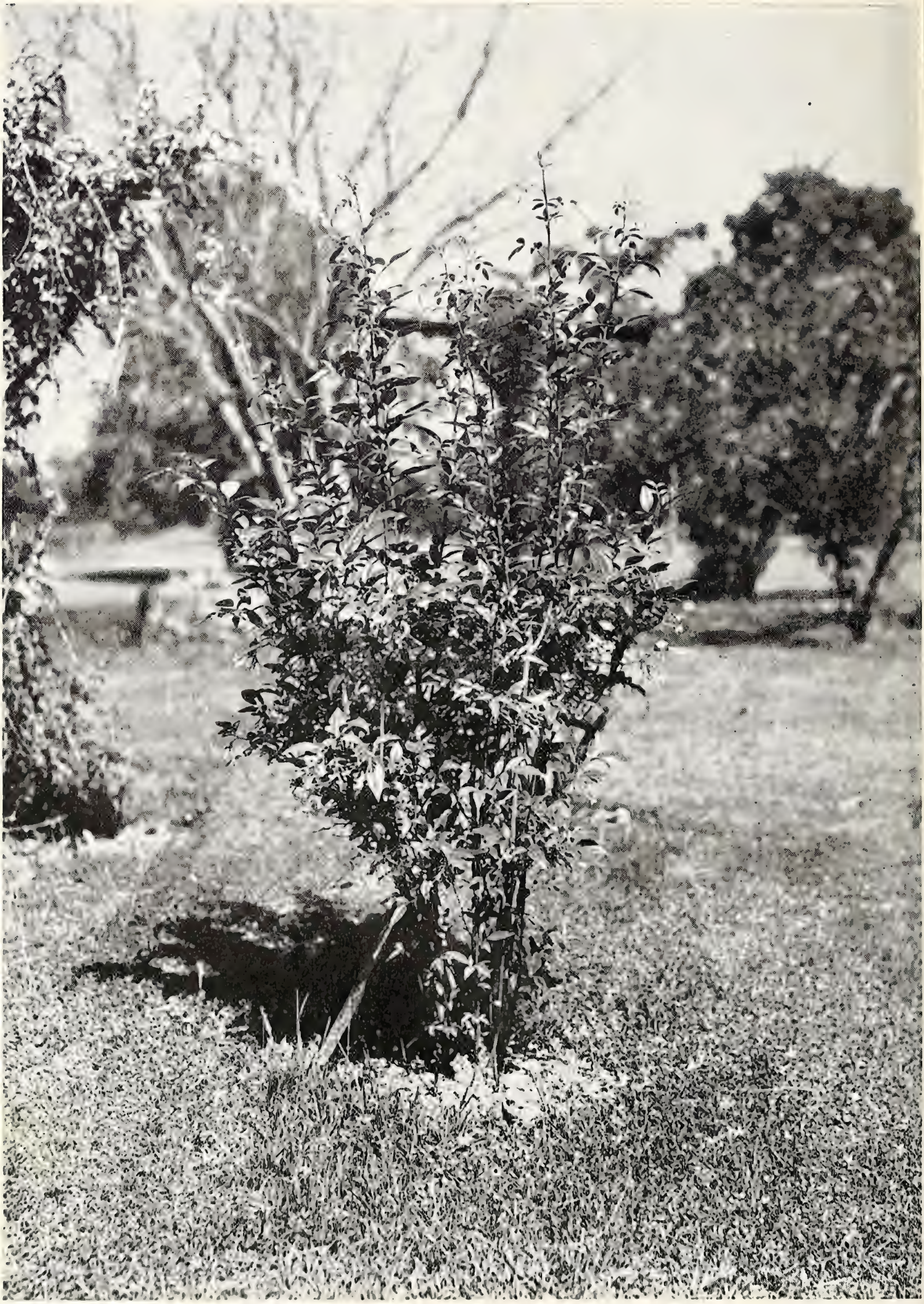

Photo by M. B. RAIZADA

The Yellow Jasmine
Jasminum humile, Linn.
New Forest, Dehra Dun

Stamens 2, included. Ovary glabrous, 2-celled; ovules 2 in each cell. Style slender, exserted in single flowers, glabrous; stigma capitate, deeply and acutely 2-lobed.

Flowers.—March-May. Does not set seed in this country.

Distribution.—Native of Yunan and China apparently as an escape from cultivation, now extensively cultivated throughout the tropical and sub-tropical parts of the world.

Gardening.—A rambling, evergreen, shrub of recent introduction. The scentless blossoms of a rich golden yellow characterize this plant. It will thrive in poor soil and under adverse conditions. It has a nice foliage and being semi-trailing it makes a successful ground cover. The plant spreads by layering itself. Propagation is by cuttings or root suckers. It was one of the first plants introduced from China by Mr. E. H. Wilson, for Messrs. Veitch of England. The double-flowered form is the one usually common in cultivation.

Jasminum humile Linn.

Yellow Jasmine.

(*Humilis* is a Latin adjective meaning low as opposed to high. It hardly is appropriate when applied to this species).

Description.—A diffuse shrub reaching 6 ft. at Dehra, evergreen, glabrous. Branches green, angular. Leaves alternate, exstipulate, petioled, imparipinnate, very variable in size, 2-3 in. long, often 6 in. long in cultivated examples; petiole and rhachis channelled above. Leaflets 3-5, very variable in size, rather thick, dark green, paler below, elliptic, ovate or lanceolate in shape, sessile or subsessile, acute or obtuse, wedge-shaped at the base, the terminal up to 4 in. long in cultivated shrubs, the lateral smaller.

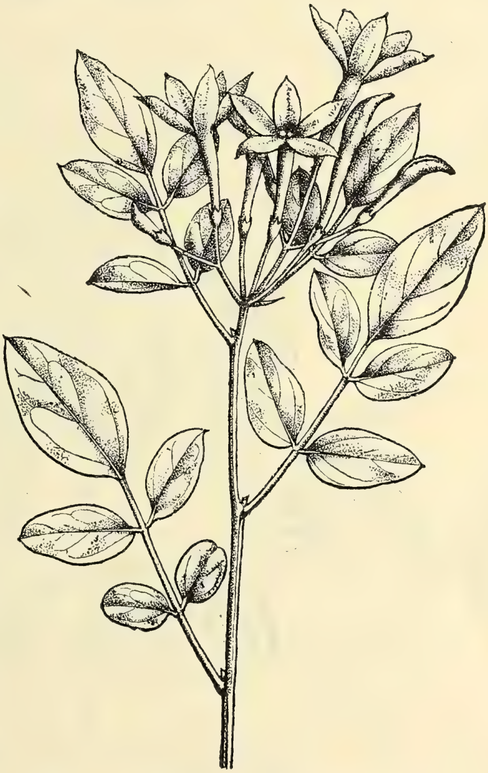

Fig. 4.—*Jasminum humile* Linn. ×$\frac{3}{4}$.

Inflorescence of terminal corymbose panicles. Flowers bright yellow, seated on pedicels, .2-.6 in. long, furnished with linear bracts. Calyx-tube .1-.15 in. long, 5-lobed; lobes .05 in. long. Corolla-tube .5-1 in. long, 5-lobed; lobes broadly ovate-obtuse or round, usually reflexed when the flower is fully open. Stamens 2, included. Ovary 2-celled, 4-ovuled. Fruit of 1-2 ripe carpels, ellipsoid, .3-.4 in. long, black when ripe, full of crimson juice.

Flowers.—April-June. Fruit September-December.

Distribution.—Native of North-West Himalayas up to 9,000 ft. also on the Salt Range, Mount Abu and Nilgiris, widely cultivated throughout the country.

Gardening.—An erect, rigid shrub with bright yellow flowers. It is advisable to prune it hard after flowering so as to keep the bush within bounds. Easily propagated by cuttings or seed. It is locally known as "shanjoi".

Medicinal uses.—This plant is not of much repute medicinally but the root is said to be useful in curing ringworm.

Jasminum officinale Linn.

The White Jasmine.

(*Officinalis* means medicinal, officially recognised as a drug).

Description.—A twiny shrub with striate branches, sparsely hairy when young. Leaves opposite, exstipulate, imparipinnate, 2-4 in. long; petiole and rhachis narrowly margined. Leaflets 3-7, the terminal 1-3 in. long by .4-1 in. wide, ovate or lanceolate, acuminate, usually larger than the lateral leaflets which are shorter and

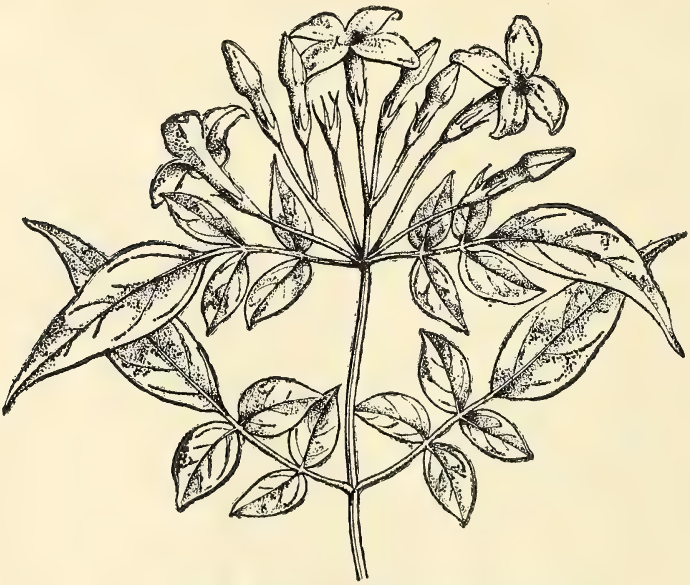

Fig. 5.—*Jasminum officinale* Linn. ×¾.

relatively broader, acute, sessile or shortly petiolulate, the distal pair sometimes with broad connate bases.

Inflorescence of terminal few-flowered corymbs or cymes and axillary pedunculate few-flowered cymes shorter than the leaves or the cymes often reduced to single flower; pedicel of the cyme-flowers .3-.7 in. long, those of the solitary and corymb-flowers often much longer; bracts up to .5 in. long, linear-subulate or narrow linear. Calyx-tube .1-.15 in. long, puberulous, 5-lobed; lobes subulate, .2-.6 in. long. Corolla-tube .5-.7 in. long, cylindrical, 5-lobed; lobes ovate or elliptic. Stamens 2, included. Ovary 2-celled; ovules 2 in each cell. Fruit black when ripe, elliptic or globose, .3-.4 in. long, full of crimson juice.

Flowers.—May-June. Fruit. October-November.

Distribution.—Native of Persia and Kashmir now widely distributed throughout India, wild or cultivated.

Gardening.—This plant, whose native home is in Persia and Kashmir, has been in cultivation in India and China since very early time. It has been introduced into the milder parts of Europe and has become established. It is a loose climbing "vine" requiring a support but scarcely self-climbing. The glossy foliage and fragrant white flowers which appear during the hot weather render the plant very attractive. Like *J. grandiflorum* it is of vigorous growth and hardy and requires periodic pruning. Easily propagated by cuttings.

Medicinal uses.—It is mentioned in Chinese medical books dated about the 17th century, as a valuable aphrodisiac. A decoction of the root is said to be of use in ringworm cases. The fruits are reputed to be narcotic and sedative. The fragrant oil from the flowers is mixed with sesamum oil and rubbed on head as a nerve-sedative.

Jasminum grandiflorum Linn.

The Spanish Jasmine.

(*Grandiflorum* means large flowered).

Description.—A large shrub with striate, glabrous, almost angled branches. Leaves opposite, exstipulate, petiolate, 2-5 in. long; petiole and rhachis margined. Leaflets 7-11 in number, the terminal somewhat larger than the lateral but not markedly so, glabrous, dark green, entire, the upper lateral pair with broad flat base, often confluent with the terminal, the lowest pair with short petiolules, the intermediate pairs sessile, the terminal acuminate at the tip, wedge-shaped at the base, the other apiculate at the tip and rounded, often obliquely at the base.

Inflorescence in lax axillary or terminal cymes longer than the leaves. Flowers white, very fragrant, often tinged with red outside, pedicellate; pedicels .5-1 in. long; bracts ovate to spathulate-oblong, foliaceous; bracteoles small, linear. Calyx-tube campanulate, .1 in. long or less, glabrous, 5-toothed; teeth subulate, two to three times as long as the tube. Corolla-tube cylindrical, .7-1 in.

long, glabrous 5-lobed; lobes elliptic or obovate, obtuse. Stamens 2, included. Ovary 2-celled, 4-ovuled.

Flowers.—Hot and Rainy season. Fruit. Cold season.

Distribution.—Native of the North West Himalayas up to 7,000 ft.; extensively cultivated in gardens both in the plains and hills.

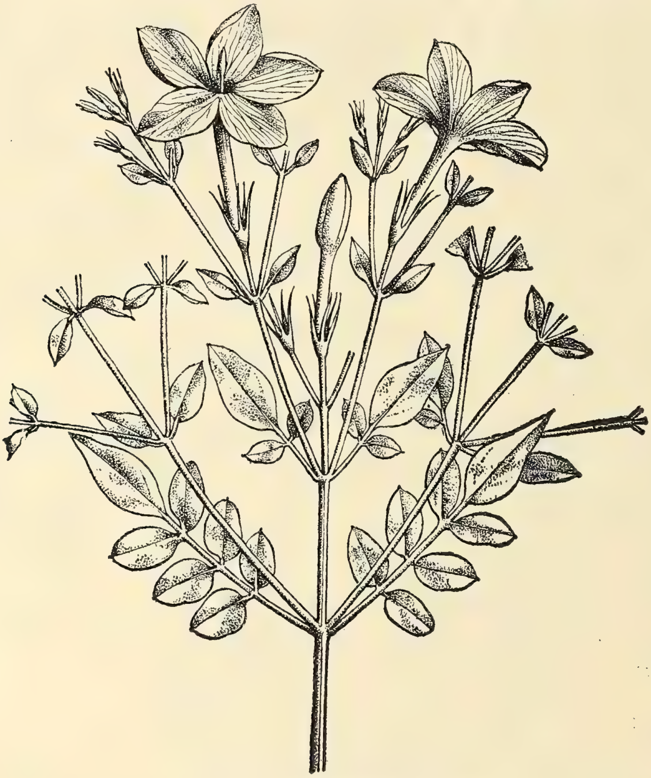

Fig. 6.—*Jasminum grandiflorum* Linn. ×$\frac{3}{4}$.

Gardening.—A large twining or scandent shrub of vigorous growth, hardy and drought resistant. The leaves are impari-pinnate and the flowers which are pure white and fragrant are bigger than those of *J. officinale.* On account of the great demand for the buds of this species it is extensively cultivated. It is rather a troublesome plant to keep within bounds as it spreads over a large space sending forth roots from its stems wherever they touch the ground. It is suitable for a light trellis and is quite attractive because of its graceful deep green foliage and scented flowers. To induce profuse flowering it is best to prune in November-December and manure in March-April. Easily propagated by cuttings. It is popularly known as "chameli".

Economic and medicinal uses.—The leaves and flowers have long been known in Hindu medicine. The leaves contain a resin, salicylic acid, an alkaloid, jasminine, and an astringent principle. The leaves are astringent in action. The whole plant is considered to

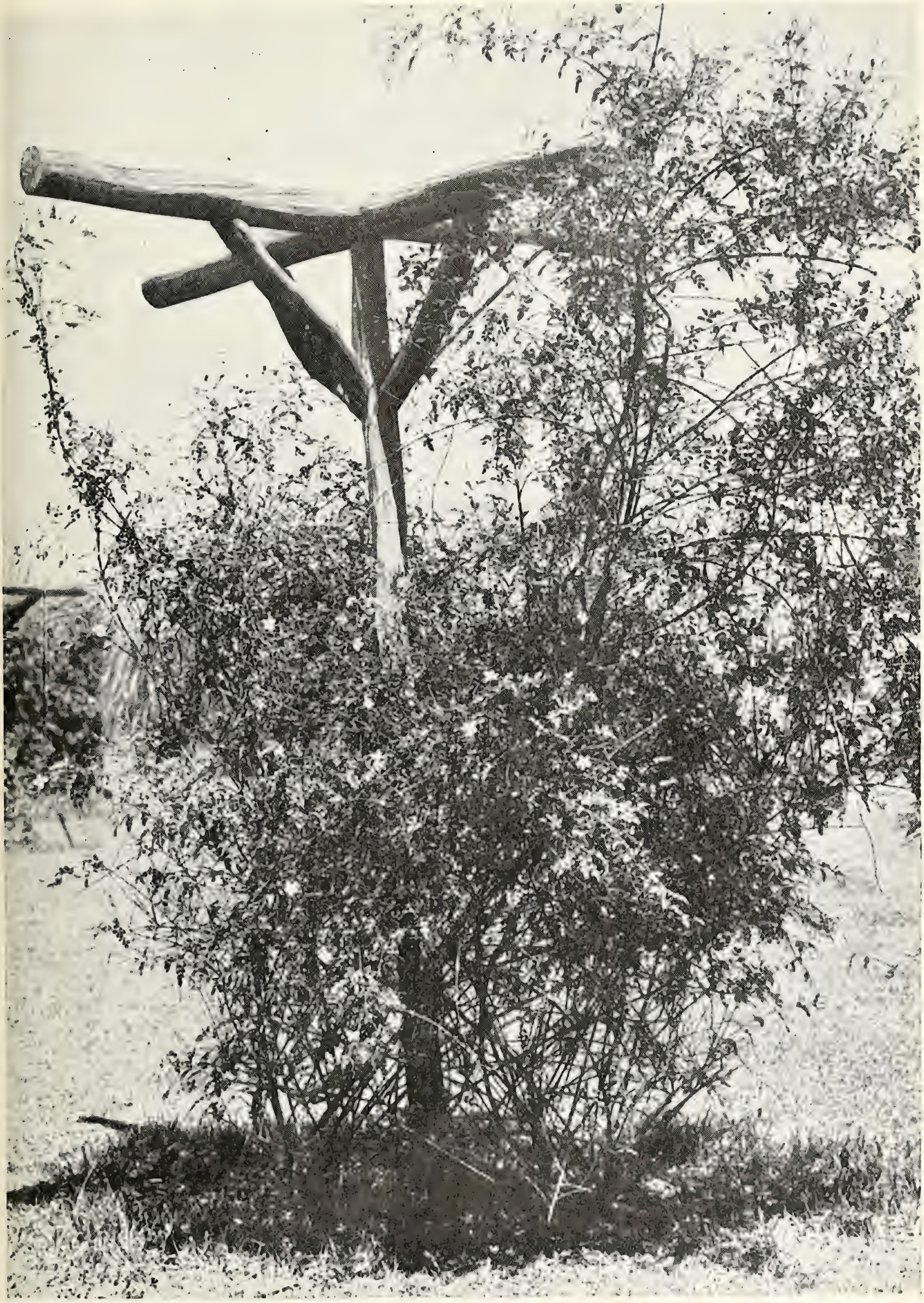

Photo by M. B. RAIZADA

The Spanish Jasmine
Jasminum grandiflorum, Linn.
New Forest, Dehra Dun

be anthelmintic, diuretic and emmenagague. The perfume from the flowers is extremely valued and is cooling in action.

This is the plant commonly cultivated in Europe for the perfumery trade. Up to the present the chemists have not been able to copy it exactly in the laboratory, as the synthesis of ketone found in the oil of the flowers, which gives a distinctive scent has not yet been accomplished. The juice is said to be anthelmintic and an antidote for scorpion sting.

Osmanthus Lour.

(The generic name means fragrant flower in Greek).

A small genus of evergreen trees and shrubs with serrate or entire, opposite or alternate short-petioled leaves. Flowers fascicled or in very short racemes, perfect, polygamous or dioecious. Calyx short, 4-toothed. Corolla short- or long- tubular, 4-lobed; lobes 4, obtuse. Stamens 2, rarely 4; inserted on the tube. Ovary 2-celled; ovules 2 in each cell pendulous from the apex; style short, 2-lobed or entire. Fruit an ovoid or globose drupe with a one-seeded stone.

Osmanthus fragrans Lour.

Description.—A shrub or small evergreen tree. Leaves opposite, petiolate, exstipulate, glabrous, coriaceous, 7 in. long by 2 in. wide, entire in wild but serrate in cultivated plants, elliptic to oblong-lanceolate in shape, acute or acuminate at the tip, wedge-shaped at the base; reticulation prominent beneath; petiole .6 in. long.

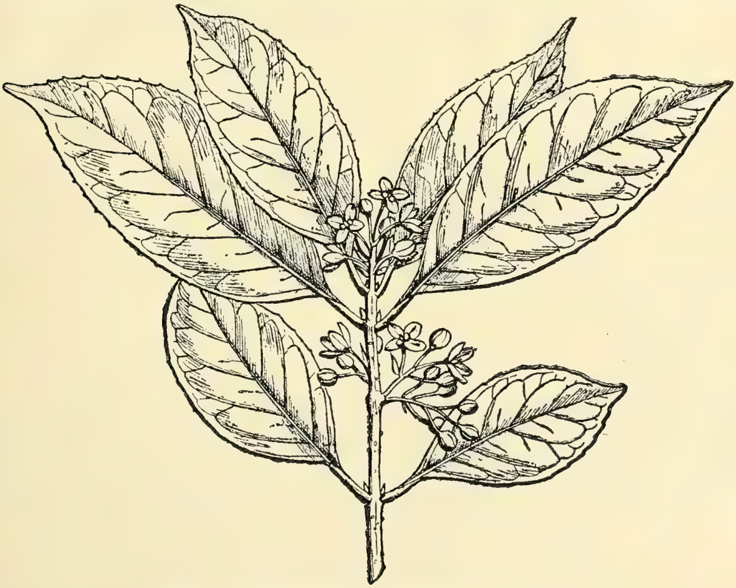

Fig. 7.—*Osmanthus fragrans* Lour. ×¾.

Flowers yellowish, very fragrant, .25-.75 in. long, densely fascicled in the upper axils, rarely terminal, shortly pedicellate. Calyx minute, .03 in. long, 4-toothed. Corolla-tube very short, 4-lobed; lobes oblong, about .3 in. long. Stamens 2, inserted in the corolla tube; anthers exserted; filaments short. Ovary 2-celled; ovules 2 in each cell, pendulous. Drupe 1-seeded.

The flowers of this species are extremely fragrant and will scent the air for a considerable distance round a plant. The sweet-smelling flowers are said to be used by the Chinese for scenting their finer qualities of tea.

Flowers.—October. Also at other time of the year. Fruits. April.

Distribution.—Native of the Himalayas extending to China and Japan.

Gardening.—An attractive, evergreen shrub with dark green glossy foliage. The tiny pale yellow flowers have a strong smell very like apricots and it is for the love of the fragrance that it is extensively cultivated. It prefers partial shade and is propagated by cuttings or 'gooties'. It is popularly known as *Olea fragrans* in gardens.

(To be continued.)

CIRCUMVENTING THE MAHSEER AND OTHER SPORTING FISH IN INDIA AND BURMA.

BY

A. St. J. Macdonald.

Part XI.

(Continued from page 58 *of volume* 46).

Locality Index.—

1. Assam and Dooars.
2. Bengal and Chittagong Hill Tracts.
3. Bihar and Orissa.
4. Bombay.
5. Burma.
6. Central India and Rajputana.
7. Central Provinces.
8. Madras (including Hyderabad State, Mysore State, and Eastern and Western Ghats).
9. Punjab and N.W.F. Province and Baluchistan.
10. United Provinces and Delhi.

Localities.

This Index of River and Tank Localities does not aim at being exhaustive, nor providing detail beyond acquainting the reader with some of the places where fishing is still to be had.

'The Angler's Handbook' and 'The Angler in Northern India' both provide detailed notes by individuals—unselfishly given 18 or

20 years ago, if the angling community to-day will co-operate on the same line and send notes on rivers and tanks listed therein, with any additional notes, to me direct or to the Society, a full and up-to-date chapter on Localities, or a second part to this book, can be compiled and published for the benefit of all.

The object of this Index is to give a brief list of Localities that the enterprising angler can trace by means of a Gazetteer, or the Road Map of India, or Survey of India Maps, or through local enquiry. The size of the river will generally indicate the size of the fish to be taken.

Detailed maps and sketches are outside the scope of this little book. The chapters on Assam and Burma include some of the best localities and must suffice until more information is forthcoming.

1. ASSAM AND THE DOOARS. See Chapter viii.

2. BENGAL AND CHITTAGONG HILL TRACTS.

Bengal is dealt with under Chapter viii, or rather those portions in North Bengal that are well known in the Districts of Darjeeling, Jalpaiguri, and Mymensingh.

The Chittagong Hill Tracts of which very little is known or, more correctly, advertised, have some good rivers in which mahseer are plentiful but owing to the difficulty in getting to the best places, and the time and 'bundobast' involved, little attention has been given to this secluded part of the Province.

Nothing is known of the Estuary fishing either; but it can be safely asserted that Bahmin and Cock-up will be found in all the many estuaries all the way down the coast to Akyab and beyond.

DISTRICT.	RIVERS & TANKS.	REMARKS.
Chittagong.	Karnaphuli. R. Sajjuk. R. Mayani. R.	I have been given most attractive accounts of the Races and Pools of the upper waters above *Rangamati* and *Barkal* in the tributaries Sajjuk and Maiyani by a non-angler.
	Sanju. R.	This river, further to the south, also traverses wild country and holds promise of good sport.

3. BIHAR AND ORISSA PROVINCES.

Bihar, north of the Ganges has numerous rivers draining through to the South-East. Above Patna the Gogra and Gandak join in from the left bank, and the Sone from the right bank, swelling the Ganges to three times its former size; further East the Kosi another huge river, runs over the country in numerous channels and joins the Ganges in the Purnea District.

There is an abundance of fish life of all kinds though little to offer the Angler, except in the smaller streams where one can have good sport with Butchwa and sometimes Silund. But for the Tank Angler this provides the best fishing in India. There are innumerable lakes formed in the Districts of Champaran and Mozufferpore which hold monster Rohu and Catla, besides all the predacious fish. There are numerous tanks dotted all over the country, almost one or two in each village, stocked with fish of all kinds.

In the Darbhanga District there are huge tanks too large to net to extinction, besides many others protected by Zemindars who will permit fishing if approached. In Darbhanga itself there are a number of large tanks, almost lakes, that hold enormous fish, in which one may fish after obtaining permission from the Raj.

To list these tanks would fill a tome. Local enquiry will soon satisfy the Angler; and the nature of the tank with its old banks and trees will indicate the age of the tank and size of fish to be expected.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Champaran.	Gandak R.	*Tirbani.* North of Bagaha, is in the N. corner of the District and is the headworks of the Canal. I have been told of some rapids below this point, but no one appears to have caught any Mahseer here though the 'Malars' bring in 30 and 40 lb. fish for sale into the local markets.
	Tanks.	*Bettiah. Raj.* Have some tanks well stocked with Rohu being protected from netting; permission to fish can be obtained.
	Lakes.	*Motihari.* Has two large lakes (the old bed of the Buri Gandak) full of fish. These lakes continue all the way down to Mozufferpore on both sides of the Buri Gandak, which flows in a south easterly direction, joining the Ganges in Monghyr District.
	Buri. Gandak R.	Fed from Nepal it is confined between high banks throughout its course in Bihar. It runs clear and is full of all kinds of fish, and gives good sport with Butchwa and Silund, but is little fished.
Mozufferpore.		*Mozufferpore.* It enters the District near Mehsi and leaves it near Pusa. The same remarks hold as those mentioned for Champaran. It passes through Mozufferpore town to the North.
	Lakes.	There are a number of lakes similar to those in Champaran in this District. Also plenty of good tanks.
	Bagmati R.	Flows into the District from Nepal near Dhang St. on O. & T. Ry. in the North of the District Mahseer have been caught at the bridge, but for the best fishing one must go into Nepal, where it is excellent, but permission must be obtained: No easy matter, as it is the sacred river of the Country. In its lower reaches it gives good sport with Butchwa and the other predacious fish. It also flows into the Ganges in Monghyr District.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Darbhanga.	Buri. Gandak R.	Enters the District near Pusa and leaves it at Rusera passing through Samastipore on its way, I know of good Silund being caught at Dowlatpore 3 miles from Rusera. It is little fished or would give good results. Tank angling is so good that the rivers receive little attention.
	Bagmati R.	The Darbhanga line crosses the river at Hayaghat Stn. It is very similar in formation to the river Gandak with the same fish.
	Tanks.	There are literally hundreds to choose from and local enquiry will satisfy any one interested. I took out of the Mohanpore tank near Ryam three Rohu one evening of 33,32,30½ lbs. and with another rod in a tank near Benipore 17 fish in three hours best 17 lbs.
Chupra.	Tanks.	In Chupra at the old Dharamsala is a very old Tank, where the fish are fed, and one can see 20-40 lbs. Ruhu come up and take parched rice on the surface; fishing is not permitted. There are other tanks but it is poor in comparison to the other Districts mentioned. The rivers are too large to be worth while.
Bhagalpore	Kosi R.	North Bhagalpore is drained by the many channels of this mighty river that knows no bounds, and shifts its course as much as 30 miles in a single Monsoon Season. From a fishing point of view it holds little attraction in the District, except for netting of the parish fish, of which there is a good supply. The Ganges is at Bhagalpore but it is a vast wilderness of water, and uninteresting from an Angler's point of view. I have heard of good fishing in the Kosi in the North of the District, but for Mahseer one must get into Nepal, for which special permission is required. I have had great accounts of the water below the last gorge and where the river fans out into a sort of delta and breaks up into several large channels and some excellent fishing is available.
Purnea	Kosi R.	The main channel of the Kosi passes under the Ry. at *Kursala* forming the boundary of the District with Bhagalpore, but is flat and sandy, and uninteresting.
	Panar & Kankai R.	Further east the Panar and Kankai rivers drain from Nepal into the Ganges, but nothing is known of the fishing. A large portion of the fish from this District is sent to the Calcutta market.

District.	Rivers & Tanks.	Remarks.
Purnea.	Panar & Kankai R.	There are a number of very old and large tanks belonging to the Darbhanga Raj, with excellent tank fishing. There are besides a number of lakes, formed by the old river bed of these wandering streams, in which good sport can be had with murrel.

South Bihar and Orissa has hilly country with a number of rivers feeding the *Sone* in the North-West, chief of which is the *Koel,* in the Palamau District which holds Mahseer, and has a number of good runs and pools near *Daltongung.*

West of *Daltongung* lie the Eastern States of the C. P., *Surguja* etc., with wild hilly country and a network of rivers, with great possibilities. Little is known of this tract of country from the Angler's point of view. The *Rer,* and another large stream just above *Bardi* join the Sone, and should hold Mahseer.

The *Bashda* rises near *Sonhat* and flows south to join the *Mahanadi,* but there must be many other good streams of which nothing is known.

Further South in Orissa are the Feudatory States with the *Ong, Suktel,* and *Tel,* all of which flow into the *Mahandai* near *Manda* in Sonpur State. The Tel is the largest of these and has a number of tributaries in *Kalahandi* State.

The *South Koel* in *Singbum,* and *Santh* further West join in *Gungpur Stream* and run on as the *Bhramini* River entering the Sea at *Hansua.*

Ganjam District is one of the districts ceded to Orissa by Madras, in the extreme South. It also has a number of rivers but no notes are available.

4. BOMBAY PRESIDENCY.

These brief Notes are only part of the wealth of information that must be available to Anglers. I have avoided mention of Sea Fishing as this is dealt with under Chapter II.

For those interested I can do no better than recommend that excellent publication by the B.N.H. Society 'Game Fishes of Bombay'. It has coloured illustrations of a number of fish and contains a host of information. It is sold at the very modest price of Rs. 2/-.

Districts.	Rivers & Tanks.	Remarks.
Ahmadnagar.	Godavari R. Prewara and Mula R.	Forms the N. and N. E. boundary with Aurangabad. These two rivers join at, or just above *Nevash* and flow on for 12 miles or so to join the Godavary; running through some wild country. *Paithan* on the borders of the Aurangabad District has a junction but no details are available. The Gazetteer would help.
Ahmedabad.	Subarmati R.	A huge pool about a mile from Cantonments below *Achar,* V, on the opposite bank, with a slow run into the top of the pool, and un-

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Ahmedabad—(*contd.*)	Subamati R.—(*contd.*)	der a cliff on the far bank. It is good in the late evenings and early mornings. I had good sport here in 1919!! and caught several fish of 4 and 6 lbs. Mahseer *Kanker-Beds.* 6 miles up-stream are some rapids we knew as the Kankerbeds, it is past the pig-sticking country, and under a cliff. I had grand sport with Mahseer of 8 lbs. and Rohu of 4 lbs. which I caught with green weeds used as a fly. It is a long, tiresome trudge, but worth it. *Rayasan.* 14 miles up-stream, and connected by bad road, has some good water but it varies from year to year. The pool at the place may go off and the water at *Koha.* V. 3 miles down improve, or at *Radasan* 1½ miles above. *Mehmedabad.* Half a mile by rail south of Ahmedabad, some good water a mile or so above the bridge. There are besides some good places up the Metre gauge line where I had good sport with fly spoon about 4 stations out. Notes lost.
Belgaum.	Gatprabha R.	*Sutgatti.* 17 miles from Belgaum holds fish up to 20 lbs. *Punderi.* 32 miles from Belgaum, with a R. H. a few hundred yards from the river, which is quite good water.
	Tamrapani	Tambulwadi R. H. and bridge over the Tamrapani stream, a tributary of the Gatprabha also holds Mahseer.
	Dhupdal L.	*Dhupdal.* Station has a large lake formed by an artificial bund which holds fish.
	Gokak Falls.	*Gokak Falls* three miles down stream has a deep pool full of fish but difficult to approach. These rivers run dirty for a considerable time after rain, which takes away from their attraction.
Bijapur.	Kistna R.	*Kistna* is joined by a river from Belgaum, I think it is the Gatprabha, which fishes well in the Belgaum District. No first hand notes available.
Bombay.	Ulhas R.	*Uhlas R.* (Kalyan Creek) the tidal part of this from Bassein up to the Railway bridge some miles above Kalyan is good for Bektie or Cock-up wherever there are rocks. Fish much over 50 lbs. have been caught on live bait. Spoon is entirely useless. Plugs are better. Fish are not plentiful. Best time August/October in turbid water. Bahmin do not ascend the creek much above Ghod Bunder.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Bombay—(*contd.*)	Kalu R.	*Kalu R.* the non-tidal parts of this, an affluent of the Uhlas, and of the Uhlas itself, hold carp and Mahseer up to and above 15 lbs. in restricted numbers. A well known spot is near ***Neral.*** Murrel and Wallago also frequent those waters.
	The Ghat Lakes.	Lakes *Andra* (L. Gibbs), *Walwan, Sheravta,* and *Mooljee* (the latter at the head of the Moola valley) all hold fairly good mahseer and carp (*Barbus dobsoni, B. jerdoni*) the largest in *Muljee* Lake. Permission to be obtained from Messrs. Tata & Co. Bombay. A collapsible punt is very desirable for successful fishing in these lakes. Trolling, spinning, and bait-casting are successful.
	Lake Tansa.	*Tansa* 55 miles north of Bombay provides part of the water supply.
	L. Bhiwandi.	*Bhiwandi* 29 miles from Bombay approached by Agra road.
	L. Beale.	*Beale* between Gote and Asvali Stations is 17 miles long. *Niphad* Stn. is near the lower lake formed from Lake Beale and connected by the Darna R.
	L. Arthur Hill.	*Igatpuri.* 26 miles S. and formed by the Bhandaradara Dam. It feeds the Pravhra. R. 14 miles of good water with fish up to 20 lbs.
	L. Andra or Gibbs.	*Andra.* A good many miles to East of Bhor ghat is also a good place.
	L. Sheravata.	*Lonavla.* In the neighbourhood is this Lake also *L. Walwan* which is reported to hold big fish. Most of the fishing in the lakes is mixed and anglers will tackle chilwa if nothing else is available. It is treated rather as a side show.
N. Kanara.	Kalinadi R.	*Kalinadi R.* This and other rivers *Gangavali, Tadri, Sharavati* (on which Gersoppa Falls, 830 ft.) all hold mahseer, together with their tributaries. All these rivers drain the District westwards into the Arabian Sea. No detailed notes are available.
Khandesh.	Girna, Tapti, Panjkra, and Bari Rs. also the Narbada for wh: see C. P. Section.	No notes in the fishing books as to these waters but there must be many places where good mahseer fishing is to be had by the adventurous angler.
Poona.	Lake Fife.	Near *Rhadakwasla.* Fish are taken trolling with spoon or dead bait. 'Mahseer Fishing in the Deccan Lakes' by Major Trevenen, *Bom. N. H. S. Journal,* vol. xxxi, p. 120 is a good reference.
	Bhima R.	*The Upper Waters.* About 10 miles north of the Nasik road the

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Poona—(*contd.*)	Bhima R.—(*contd.*)	river is fishable for mahseer up to 10 lbs. or so in various runs, during and immediately after the rains for a short time only. There is a rocky chasm quite often holding huge goonch and fair-murrel, besides mahseer. *Bhima R.* This holds good for the fish in the fine pool below the confluence above *Pargao* village, I have seen mahseer of 30 lbs. netted there. The big pool near *Nandgaon* (off *Patas*) is too broad for fishing from shore. It becomes shallow in the dry weather and is good in and shortly after the rainy season only, when large fish may frequent it. The rocky runs below the pool, and the water into which they run, are also good in the same season. A dug-out canoe is usually procurable at the big pool at one or other of the villages. Patas is 40 miles from Poona on the Sholapore road.
	Mula R.	*The upper waters of the Mula,* i.e., from above Kirkee to Kooljee Lake, present several fair runs shortly after the rains and good pools throughout the year with carp and mahseer rarely over 10 lbs. Also fair murrel and wallago *Mutha-Mula R.* The pool at Kirkee is still fairly tenanted. There are now three dams below it including the one near the Fitzgerald bridge, so that fish can no longer reach their old spawning grounds in the upper valley. The spot near 'Snake Island', which still haunts the literature, is completely useless since many years for spinning and trolling and holds no sizable mahseer nowadays. The stretch below the bridge and up to the Cavalry falls is still frequented by a few fish up to 25 lbs. during and shortly after the rains, but sizable fish are few and far between. They respond to spoon, dead bait, and plug, but prefer paste, crab, or such country baits as chapati or a triangular slice of coconut spun like a spoon, with a single hook tied to it, or better still the single hook concealed between two thin slices. This is a very killing bait in slightly coloured water. It spins very well in fairly fast water and is very attractive. Further down there are good runs at *Loni* and *Theur* yielding fish of the same size, but not many.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Poona—(*contd.*)	Mula R.—(*contd.*)	I believe that the three dams in Poona have made the river unpopular with mahseer as these three dams create a dead end, or 'culdesac'. The pool just above the confluence with the Bhima still holds a few good mahseer, but they disdain all artificial lures. Bottom fishing is the only way with them.
	Ghod R.	*Ghod R.* The part north of the Nasik road runs through pretty wild country and holds some great fish in the vicinity of *Ambegaon* Fishable after the rains. This part is not easy of access and camping is a necessity. A deep, rocky chasm on a small tributary some 16 miles from *Sirur* holds large fish (mahseer and silund) very difficult to land as the rocks are high above the water. This is certainly the place mentioned in Thomas's 'The Rod in India' 2nd edition 1881, page 337. The word 'Dav' in the same para probably refers to the village *Dehu* on the Indrayani River in the Poona area. I have seen mahseer up to 50 lbs. netted in the *Ghod R.* some six miles from Sirur where their retreat down river had been barred by a palisade of stakes. This was after the rains when large fish retire from their spawning grounds in the Ghats and return to the deeper waters of the Bhima lower reaches. Very large goonch are also caught there. This, by the way, is the type locality for Sykes's *Barbus mussulah* the very hump-backed and heavy, golden-bronze coloured mahseer of the Deccan, which I believe to be identical with the record fish of the Cauvery river. It is distinct from the ordinary more Slender Deccan Mahseer which Dr. Hora has classified as *Barbus* (*Tor*) *khudree*, Sykes. All the above as to Poona rivers also Ulhas R. and Ghat Lakes is, contributed by Dr. M. Suter, D. Sc., and gratefully acknowledged.
Poona.	Indrayani R.	*Shelavadi* Station on Lonavla-Poono line is 4 miles from Dehu where is a temple and pool full of sacred fish up to 40 lbs. and over.
	L. Whiting, Nira R.	*Bhartgarh.* The Lake is formed by the Lloyd Dam and Nira R. which also carries off the overflow. Good fishing is reported in both the lake and river. *Ing.* 3 miles below the lake has some good runs.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Satara.	Warna, Keina, Yerla Rs.	The Warna is in the South. The Koina runs through the centre, and the Yerla in the East of the District. All are tributaries of the Kistna and must hold fish. No notes available.
Surat.	Parr R.	*Bulsar.* Take a bus on to the river. Good sport is reported both above and below the Ghat.
	Kolak R.	*Udvad Stn.* The river is two miles south of the Station. Holds mahseer and other fish.
	Dhamanganga R.	*Dhaman Rd. Station.* The river is 1½ miles South of the Station. A few miles up-stream is reported to be well stocked with fish, both fresh water and estuary. Two miles below the Ry. bridge and near the Salt Dept. bungalow is reported to have good estuary fishing.
	Sanjan R.	*Sanjan R.* 1 mile South of the Sen Station is well stocked with estuary fish.

A reference to the Road Map of India will show the Angler that there are great possibilities for estuary fishing all along the Surat coast where the Tapti and Narbada rivers enter the sea.

5. BURMA, see Chapter vii.

6. CENTRAL INDIA AND RAJPUTANA STATES.

Little is known of the fishing in this vast area, except perhaps by the privileged few, keen on fishing, who have served in these States.

There are said to be large mahseer in some of the Udaipur Lakes. In earlier days, as we know from articles in the Oriental Sporting Magazine of the middle 19th century, the Chambal river and its many tributaries afforded large catches of *Barilius Bola.* It is probable that the same species still afford opportunity to those who can visit those regions.

Skene Dhu makes brief mention of indifferent fishing near Mhow. Notes regarding the Narbada River in the Central Provinces and Bombay localities lists should be referred to.

Any Notes on the Chambal and other rivers would be of interest to Anglers and science alike.

STATE.	RIVERS & TANKS.	REMARKS.
GWALIOR STATE. Kotah, Bundi, Nerwar and Datia	Chambal R.	The largest river in Central India. It rises in Indore near Mhow taking in a large number of tributaries of considerable size which rise in Kotah, Bundi, Nerwar, Datia, etc. It runs in an Easterly course skirting Gwalior State on the North to join the Jumna near Etawah. (U.P.).
Indore State.	Nerbudda R.	*Mhow.* is well situated for the streams in the South of the State that drain the Satpura R. into the Nerbudda.

DISTRICT.	RIVERS & TANKS.	REMARKS.
Rajputana.	W. Banas R.	*Banas R.* rises in Sirohi in the South the drains the western portion of the Aravalli Range, and runs into the Runn of Kutch.
	Sabarmati R.	*Sabarmati R.* also rises in this range (for notes on this R. See under Ahmedabad).
	Mahi R.	*Baswara & Durgapore.* The Mahi rises in the hills in these districts, it is wild hilly country, but nothing is known of the fishing or fish.
	Banas R.	Not to be confused with the Western Banas which runs west. The Banas also rises in the Aravalli R. but follows a North-Easterly course, taking in the Kheri, Kotari, from the West and the Berach from Tonk State near Udaipur. The Banas joins the Chambal about 20 miles East of *Sawai-Madhopur Jn.* on the B. B. & C. I. Ry.

7. CENTRAL PROVINCES.

This Province may well be divided into four sections. The North is drained by the tributaries of the Jumna; the West and Centre by the Narbada and Tapti flowing into the Arabian Sea. The South and South West and greater part of the Central portion is drained by the largest of its rivers flowing into the Godavary through the Warda, Penganga, and Wainganga, which form the Pranhita. The East has the Mahanadi and Seonath, with their many tributaries, leaving the Province at Chandranpur.

DISTRICT.	RIVERS & TANKS.	REMARKS.
Amraoti.	Ganga, Katbi, Sipna Rs.	*Ellichpur.* For full details see under Khandwa.
	Wainganga River.	Dongaghat is a good place with fish over 20 lbs. The large fish are taken on atta, the smaller ones take spoon. For further details refer to District Gazetteer for detail of approach. Padregunj, a little south of Nainpur on B. N. Ry. has some excellent water, I have heard of big fish being taken and others lost. The Laknagunj Gorge, up-stream a couple of miles, is a celebrated place, fish take both spoon and atta.
Bhandara.	Wainganga R.	*Wainganga R.* there is very good fishing in this District but I regret I have lost the Note sent to me by a Forest Officer who caught some good fish both in this river and the one which drains the District further East! (name not available). It joins the Wainganga just north of Ambgaon (in Chanda) in the extreme South of the District. Fish well over 20 lbs. were caught by this rod.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Bhandara—(*contd.*)	Wainganga R.—(*contd.*)	36 miles from Nagpur on the Raipur road are some good rapids down stream about 9 miles. Bait with atta, then fish with spoon or paste balls when fish have collected.
Bilaspur.	Hasdeo R.	*Hasdeo R.* a tributary of the Mahanadi and joining it at Seori Narayan a few miles below. Banjo in Uprora Zemindari has some good water; Best mentions in his Shikar notes some good water 15 miles north of the Railway.
Chandrapur.	Mahanadi R.	*Mahanadi R.* Padampur, and water between Seori Narayan and Chandrapur is good, with fish over 20 lbs. For details refer to Dist. Gazetteer.
	Maniari R.	*Maniari R.* a tributary of the Seonath R. and joining it at Satti Ghat about six miles S. S. W. of Bilha Ry. Station or 15 miles S. W. of Bilaspur. *Lormi* on this river is mentioned by Best as a good spot, and fishes all the year round. Fish of 5 lbs. have been taken. The route to Lormi is *via* Mungeli 30 miles, then by track for 16 miles. There is a Rest House, P. O. and Police Station at Lormi on the banks of the river. 30 miles from Bilaspur where the Raipur road crosses the river, is said to be good.
	Seonath R.	*Seonath R.* Nandghat. A good run 600 yards above the bridge, and another run about the same distance below.
Buldhana.	Tank.	The drinking water tank has good Murrel and a few Butchwa. Good fun can also be had with chilwa with a fly. It is a mile out.
	Khamgeon Tank.	*Khamgeon Tank* also has a large tank and it is here I have caught Murrel on fly in the evening and when the shoals are rising. The only place I have found Murrel rise in this way.
Chanda.	Indravatti R.	*Indravatti R.* joins the Godavary in the S. E. corner of the district. Allapillai 75 miles then on to Repanpalli 21 miles along the Seroncha road. Turn off the main road close to R. H. and go East by a cart track to Damarincha (15 miles) to Palli another 15 miles, total 51 miles, near Damarincha is the Bandia R. a sandy bed and heavy going. Except for this river the cart track, offers no difficulty. Make for Bhamragarh 4 miles upstream where there are several runs and reports of monster but elusive fish. At Bomragarh is a Bungalow.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Chanda—(*contd.*)	Indravatti R.—(*contd.*)	Semanapalli about 6 miles above junction of Indravatti and Godavari has a pool full of big fish. A Forest R. H. here. One hears wonderful accounts of monster fish of 80 lbs. being seen and tackle broken. It has always remained a dream of mine. An old shikari reading these notes writes that when he was at Warda. Junction on 22nd March 1898, on way to Chanda and the Indravatti, he met an Officer from Poona who had had all his tackle torn to bits by huge mahseer of the Indravatti. He (my present informant) was at Damarincha by the 26th April 1898 and caught a small mahseer of the thick lipped type. Then he got bad remittent fever and had to return to Cantonments. It was not until 1929 that he was again able to get to the Indravatti and that was at end of April. He fished from Bomragarh for several days, trying all methods, without success. He had the impression that the river had been largely denuded of fish owing to extensive killing of all fish and fry in the upper waters of the river and its tributaries by the aboriginal inhabitants of Bastar State. During his stay the locals were unable to get *any* fish by means of cruives or other means. In 1924 a friend had lost a very big fish in the long, deep pool below the Bungalow. It was hooked on atta. Probably the season for the Indravatti River would be February and March, and again after the Monsoon. Fever would have to be guarded against.
	Pranhita R.	*Pranhita R.* runs into the Godavari R. in the extreme South of the district and I have heard wonderful accounts of monster fish of 80 lbs. being seen, and tackle being broken. These waters have always remained a dream of mine and though I have planned to visit South Chanda twice I have never managed to do so.
	Wainganga R.	*Wainganga R.* four marches from Chanda on the Sironcha road the fishing water is both above and below the cause way for about a mile. Fish of about 15 lbs. have been taken. In this District, in the South East corner, is a host of places; but they are very difficult

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Chanda—(*contd.*)	Wainganga R.—(*contd.*)	to get at. Were it not for this the fishing would have lured the keen angler long ago and many a good bag would have been recorded.
Chhindwara.	Penchi R.	*Penchi R.* a tributary of the Wainganga rising in the hills South of Pachmarhi.
	Jilmilli.	Jilmilli 14 miles from Chindwara on the Seoni Road is reported as having good water. Kundlai is a small village in the corner where the three districts of Chhindwara, Seoni and Nagpur meet, roughly 25 miles S. W. of Seoni. Khawasa about 30 miles from Seoni on Nagpur Road 12 miles West the River is crossed, and has good water. Bait with gram or atta for small fish of 5 lbs. or so. Alikutta is 6 miles upstream from Kundlai is mentioned as fishing well in the early part of the Season.
Damoh.	Bearma R.	*Bearma R.* Nohta, 52 miles on Jubbalpore road is a R. H. on the banks of the river. Best water a short mile up-stream. Best in the early part of the season water too low in the hot months.
	Ken R.	*Ken R.* the line to Katni crosses one of the main tributaries of the Ken about 30 miles from Damoh. Good at Ghat Piperia in the early part of the season. A good block for tiger with a nice F. R. H. overlooking the river.
	Sonar R.	*Sonar R.* Narsinghgarh, 10 miles North of Damoh. A large pool below a high bank on the right bank of the river from which big fish of 30 lbs. can be seen on occasions. The river is about half a mile N. W. from the R. H. The best time is early in the Season while the runs are still strong. Bait, gram and atta. Hatta, 22 miles by road to the North of Damoh is another place mentioned.
Hoshangabad.	Nerbudda R.	Two runs opposite the Judge's Bungalow. One well out in the River the other near the bank. The further one is the better of the two. Bandraban, 6 miles up-stream from the town, the Tawah joins the Nerbudda. Above this is good water. Bait atta or gram. Best season April/May, fish run to 10 lbs. Karraghat, the Ry. crosses the river two miles west of the town, this is good water, if runs are first baited with atta.

District.	River & Tanks.	Remarks.
Hoshangabad—(*contd.*)	Nerbudda R.—(*contd.*)	Nandpa, 20 miles S. W. of Hoshangabad is another good spot after baiting with atta. Gadarvada Stn. 72 miles East of Itarsi the line crosses the Shakkar R. a tributary of the Nerbudda R. Two or three good pools within 4 miles of the Station and one very good one half a mile above the bridge.
Pachmarhi.	Denwa R.	*Denwa R.* at Pachmarhi small fish have been taken in Oct. on fly spoon at Panzy-pool and Waters-meet. Above *Matkuli* is also mentioned as good water. Fullers Khud small fish can be taken on atta.
Jubbulpore.	Nerbudda R.	*Nerbudda R.* Bargi, 14 miles out on Seoni Road, the river is about two miles from the road. The Tamer joins in near here. Three runs worth fishing with gram. Bahoripar is 9 miles down the Seoni road where a track takes off, motorable in dry weather, about 1 mile distance. Cross the Ry. and the river is about 1 mile further on. Bait with gram before fishing. Guwarighat, 5 miles down Seoni Road. Runs are only a few hundred yards away. There is also some good water near the Ry. Bridge 2 miles up the river. Tilwaraghat, 8 miles from the town or 3 miles below Guwarighat, has a good run and I have heard of good fish being taken on gram and atta. Lamheti is two miles further down, and has three good runs. *Bheraghat,* Notha 52 13 miles from Jubbulpore, has a R. H. run below Bungalow holds fish.
	Bearma R.	*Bearma R.* Notha 52 miles down the Damoh Road. Fishes best in Oct. after the rains, when good sport can be had with not only mahseer but Silund and Butchwa.
	Belkhund R.	*Belkhund R.* Dhanwani & Chugra. 33 miles from Jubbulpore. Follow Sehora-Khamtara Road to $5\frac{3}{4}$ mile stone, and turn South along track to Chugra. Dhanwari is about a mile up-stream. Some nice pools and small runs.
	Gaur R.	*Gaur R.* Guraiyaghat, 5 miles out on Mandla Road, good fun can be had below the causeway in a fine spell during the rains or in October when the water clears. Kosamghat, 4 miles up-stream, has one or two nice pools, much fancied by Indian fishermen. Pararia, $1\frac{1}{2}$ miles down-stream

DISTRICT.	RIVERS & TANKS.	REMARKS.
Jubbulpore—(*contd.*)	Gaur R.—(*contd.*)	has a small bund across the river which breaks up the water and is good after the rains for small fish.
	Goorda R.	*Goorda R.* in the Seoni Road, looks a likely river, for small fish.
	Hiran R.	*Hiran R.* Ganiari, Leave Jub-Damoh Road at 17½ milestone and take cart track for a couple of miles. Some nice runs and pools which hold good fish. Kakarhatta, 20½ miles down Damoh Road. Some four good runs here and ask for Mawah and Bandar Ghats, the two best places.
	Mahanadi R.	A tributary of the Son and Ganges, which rises in Mandla, and joins the Katni R. North East of Katni town. Crossed by the Shahpura Road at mile 37, where the water looks good. Wasari, 16 miles East of Katni on the Barhi Road is the only place I know where it has been fished with success, but it is a fast flowing and rocky stream and must be good in a number of places. Fish will take spoon in this river besides atta and gram.
	Temar R.	*Temar R.* joins the Nerbudda near Bargi, and has fished well at times. Basanpani, Temar and Bargi all on the Seoni Road are favoured spots, but I have no details of sport.
Khandwa.	Ganga R.	*Ganga R.* is crossed by the Burhampur-Edichpur Road 5 miles West of Dharni village and 2 miles from its junction with the Tapti. Dharni has a R. H. and P. O. and is 58 miles from Ellichpur. There is good fishing here and lots of good water for gram and atta. Tapti fish do not fancy spoon.
	Katbi R.	*Katbi R.* is a tributary of the Ganga. Balkhund has a R. H. overlooking a big pool full of fish. It is 18 miles from Harisal on the Akot Road. When the river is high there is a fall into the pool and must be good. No details available.
	Sipna R.	*Sipna R.* also feeds the Tapti joining it at Kegda a few miles N. E. of Dharni. Melghat, Best claims to have caught Mahseer with spoon, both large and small. Other places mentioned are Semadoh, Rakhidih, and Harisal.
Mandla.	Nerbudda R.	*Nerbudda R.* Dindori, 50 miles N. E. of Mandla is reported to have fished well. Sahasradhara is only three miles down-stream from Mandla where

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Mandla—(*contd.*)	Nerbudda R.—(*contd.*)	there is a nice fall at the head of a deep pool. Large fish have been hooked here. Imdhi, 6 miles from Mandla on the Jubbulpore Road has a small fall at the head of a nice run which widens into a deep pool and holds big fish.
	Thanwar R.	*Thanwar R.* is a tributary of the Wainganga and is best approached from Padregung. I had a note years ago by a Ry. Official who caught some good fish of 20 lbs. and over and lost a lot of tackle in others. Fish take a spoon in the Wainganga system.
Nagpur.	Penchi R.	See notes under Chhindwara.
	Wainganga R.	The river forms the border of the district in the E. with Bandara, there are some good fishing spots.
Narsingpur.	Nerbudda R.	Barhman to the N. and where the Saugor Road crosses, there is some very nice water, and good sport has been had fishing with atta and gram.
Nimar		The Dharigha Falls: a grand place for fishing. Season after the S. W. Monsoon, as soon as the river begins to clear. Also March but then heat is very great. There is a basaltic barrier across the whole river, about 500 yds. wide at this point. The water falls in a series of cascades through passages worn in the rock. Fall of water level about 40 feet. Fish of all species in the river are here. Mahseer up to 20 lbs and more, large perrun and many murrel muggger. Live bait, and natural bait and spoon spinning, all successful, spoon least so, Plug not tried would probably do well. No accommodation on the South bank, a village on North bank (Dhar State) from which supplies and men can be had. Approach from Bir railway Station on G. I. P. Ry. *via* Punasa (F.R.H.) which is 6 miles from the Falls and 18 miles from Bir. Better to take men and supplies from Punasa with kind assistance of Forest Ranger. Boat necessary for access to further bank, and also to rocks in river. The South side of River is all Reserved Forest. 25 miles below is Mandhata where a number of boats. Many mahseer opposite the Temples on either bank. 7 miles below Mandhata is Road & Rail bridge over the river. Sta-

Districts.	Rivers, Tanks & Lakes.	Remarks.
Nimar—(*contd.*)		tion Mortakka. Good water below the bridge. Excellent runs for gram fishing. From Mortakka to Kalghat (by water) 40 miles; and from Kalghat to next place where motorable road touches the river 40 miles (by water): all this portion of the river should be good, but probably never fished by any angler. So also the next 90 miles all of which runs through hilly country. Must be any amount of good water and probably many rapids. Only way to fish the river from Mortakka to the furthest point would be by boat, and take some considerable 'bundobast', but worth it! Certainly never been fished by anyone.
Saugor.	Betwa R.	Almost the best river in the province as fish will take a spoon and run to a decent size, for further notes on this river see under Jhansi in U. P. section. Bina, there is some very good water near here, and fish run large. Kanjia, 15 miles from Bina. Approach *via* Mamboali on Bina-Goona line. Make for Kanjia about 5 miles away. 1 mile below is a good run but it must be fished early, Oct. or the river shrinks and has not enough water in the hot months. Try spoon, atta and gram.
	Bewas R.	*Bewas R.* crossed at the 12th mile on the Damoh Road, and at the 9th mile by the Narsingpur Road. There is good water at both places. Best in Oct. or in a break in the rains, when one may get into a good Silund.
	Dhasan R.	*Dhasan R.* the river is crossed 10 miles from Saugor on the Jahnsi Road. It fishes well after the rains and good fish have been taken 15 lbs. and over.
Seoni.	Goorda R.	See note under Jubbulpore.
	Pench R.	See under Chhindwara.
	Wainganga R.	Chhapara, 20 miles down the Jubbulpore Road there is a R. H. near the bridge. A good pool a mile down-stream with fish of 6 lbs.

There was an Angling Association formed for the C. P. with its H. Q. at Jubbulpore, they published a Journal with a lot of useful information for the Resident or visiting Angler, but I cannot say if this is still functioning, I am talking of 1930-31.

Any one interested should try and obtain a copy of the Journal sold, I think for Rs. 2-8.

(Including Hyderabad State, Mysore State, Eastern and Western Ghats.)

8. MADRAS FISHING LOCALITIES ARRANGED BY PROVINCES.

Hyderabad State.

Within this area, or forming part of its boundaries, are the *Godavary,* with its tributaries *Pranhita, Penganga,* and *Manjra;* and the *Kistna* with its tributaries *Bhima* and *Tungabhadra.*

All these great rivers hold Mahseer and sport is to be had with them wherever there are rocks and rapids by spinning, and in deep, still pools by bottom fishing: so also with other large carp and sporting fish of several species.

For very many miles on end portions of these rivers, such as the Godavari between Nander and Sironcha and from thence down to Rajahmundry; and the Kistna from a few miles below the G.I.P. Railway Bridge north of Raichur nearly all the way to Bezwada are almost unknown to the Angler. There are also long reaches unattractive to the angler because of alluvial soil and sluggish currents. This applies to almost all of the Manjra River. Where the Renganga and Godawari run through the northern jungles of Adilabad and nirmul those rivers offered good sport in many places.

Generally speaking the Kistna and its tributaries offered the best sport from early November when the waters begin to clear after the S. W. Monsoon, up to March or April. The Godavari and its tributaries do not fish well until somewhat later on account of the colder climate up to middle or end of January.

DISTRICT.	RIVERS, TANKS & LAKES.	REMARKS.
Hyderabad State.	Hussain Sagar & Mir Alam Lakes.	These large Lakes are stocked with all the usual species of Tank fish, and good sport can be had from the embankments. Information could be had as to baits and methods from a number of local Anglers, mostly Muhammadans. Besides these two lakes there are many large artificial Lakes and Tanks throughout the State in all of which sport could be had.
	Kistna R.	*Kistna R.* good water above the bridge for 3 miles and down-stream for a number of miles. There used to be a Bungalow, more or less unfurnished, at Devursugur 3 miles below the bridge on the right bank. Permission from the Tahsildar, Raichur. Officers of the Hyderabad Contingent had great sport in this part of the Kistna also in the Bhima (from Yadgiri) about fifty years ago. The fishing may still be good. 16 ft. fly rods and fly spoon were used, killing mahseer up to 40 lbs. and over. A portable collapsible boat is necessary. The

Districts.	Rivers, Tanks & Lakes.	Remarks.
Hyderabad State (*contd.*)	Kistna R.—(*contd.*)	7 ft. Berthen was found excellent. Suitable boats not locally available.
Yadgiri Stn.	Bhima R.	Half a mile from Railway Stn. good pool and runs. Mahseer up to 40 lbs. Portab boat essential for real success. No boats available locally. Accommodation in Station waiting room. The junction of the Bhima with Kistna is about four miles above the Ry. bridge, but is not attractive for fishing.

Except as above there are no detailed note available for the Rivers and Lakes of the Hyderabad State.

Murrel: Large fish of this species are to be found in a number of the deep, spacious, masonry wells in various parts of the country. They run to 10 lbs. in weight and it is surprising that more attention to the cultivation of this excellent table fish in this manner has not had more attention in many parts of India.

Eastern Ghats.

The *Sabari* and *Sileru* rivers, in the portions of them flowing within, or on the borders of the Jeypur state afford good mahseer fishing from early February on to end of May. The latter is the larger and better river with fish up to 30 lbs. These rivers are only accessible to the turing official or the sportsman on a shooting expedition. The mahseer take spoon.

The two rivers meet at the S. E. corner of the Bastar State and the combined river joins the Godavery 20 miles south, below Bhadrachallum.

Districts.	Rivers. Tanks & Lakes.	Remarks.
Jeypur State.	Sileru R.	*Sileru R.* the river has that name from the junction of the Machkund R. (always muddy) with the Gurepreo, R. (always clear.). Eight miles up the latter on the left bank is a Bungalow, Janwai. The junction is at Kondakambru where is also a Bungalow. There is a fine pool at the junction. From here to Konta where the river joins the Sabari is approximately 60 miles. First 45 miles through a valley with hills on either side and forest all the way. All the Game animals and birds. Many muggers. A few riparian hamlets. Malaria prevalent. No supplies. Trip can be done by means of dugout canoes which are available from Kondakambru. Allow ten to fifteen days.
Malabar.	A number of streams; also Beypur. R. Palanted. R. and Head waters of Kabbani. R. flowing east.	Remarks as for S. Kanara.

DISTRICTS.	RIVERS. TANKS & LAKES.	REMARKS.
Travancore State.		High Range. In this area are many Tea Estates. Some of the streams have been stocked with Rainbow Trout by the Planters Fishing Association which controls the fishing. Tributaries of the Periyar R., and of the Chalakudi. R. (Cochin State) hold mahseer.
,,	Periyar Lake.	Holds big mahseer which are seldom caught. Sizable fish can be got from the Dam with plug bait. Area of Lake is 14 square miles, much of it studded with dead tree trunks. Very little water escapes below the Dam. There is a mile long tunnel taking water into the plains of Madura to east of the high hills in which the lake is situated. The Periyar river enters the lake in its eastern corner. Mahseer run up the river at time of the monsoons. When the river clears spoon fishing can be good. No access to the river except by boat and nothing can be done in the lake without a boat. The fishing in the Pariyar area is controlled by the Vandiperiyar Planters Fishing Association.

Madras.

The fishable (hilly) portions of the Travancore and Cochin States rivers are less accessible than those of Malabar and South Kanara.

Most of the Travancore streams, even in their remotest parts, have been practically denuded of fish by gangs of poachers; this may also be the case with some of those further north in S. Kanara and Malabar.

The main mahseer rivers are the Godavery, Kistna, Tungabhadra, Cauvery, and Bhavani. Except as to the Bhavani no detailed notes are available.

Coimbatore.	Bhavani R.	*Bhavani R.* for full information see article by Lt.-Col. R. W. Burton in the *Journal of the Bombay Natural History Society,* vol. xli, 828. Season July and August and September and January February.
Salem.	Cauvery R.	*Cauvery R.* from the Sivasamudram Falls until it reaches the north corner of the Mettur Lake at the Hogenakal Falls, a distance of some 90 miles approached nowhere by motorable roads or even cart tracks, this portion of the river should afford fine sport and can have been seldom, if ever, fished by an angler for mahseer. The trip could be done with 2 coracles one for fishing, one for followers and supplies. All supplies

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Salem—(*contd.*)	Cauvery R.—(*contd.*)	would have to be taken, nothing available. Season from mid January to March. A good and adventurous trip well worth undertaking. Malarial precautions necessary. The mahseer would run large.
Godavari.	Godavari R.	*Godavari R.* this river is within the Madras Presidency or on its border from 30 miles below Sironcha until it flows into the Bay of Bengal near Coconada. There is good water where the river narrows below Bhadrachalam, and at a number of places where the river winds its way through the hills south of latitude 17.30 and 40 miles north of Rajahmundry. All this part of the river is known to only a few anglers who may have been serving in that part of the Presidency. No notes are available.
Kistna.	Kistna R.	*Kistna R.* from Kurnool to Bezwada the river is the Southern boundary of the Hyderabad State and northern boundary of Madras Presidency for 150 miles below Kurnool the river flows through a deep, jungle-clad gorge which has probably never been fished by an angler for mahseer. There are no roads or cart tracks. Many muggers. The trip could only be done by basket boat as for the Cauvery. Supplies would have to be taken. The heat would be great and the sport perhaps, phenomenal! Season early November to March.
	Mettur Lake.	*Mettur L.* formed in recent years by Hydro Electric Dam at Mettur. Lake 30 miles long varying in width from 5 miles at widest part Depth at the Dam and about 30/40 ft. at north corner where the Hogenakal Falls former 70 ft. high. Many large fish collect at this place. Half way up the lake the Palar R. comes in from the west. Here follow notes from Mr. Madhavan Nilgiris.
Nilgiris.		In this area are many streams, and a few artificial lakes, which have been stocked by the Nilgiri Game Association with Rainbow Trout. These streams are the head waters of the Bhavani and Moyar rivers. Some of the lower portions are open to coarse fishing but almost all is for fly fishing only. All information from the Secretary of the Association at Ootacamund.
	Neyar R.	*Neyar R.* forms boundary between Nilgiris and the Mysore State

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Nilgiris—(*contd.*)	Neyar R.—(*contd.*)	and runs in a thousand foot deep gorge known as the Mysore Ditch. Holds large mahseer and other carp but is seldom fished on account of malarial fever of a bad type and difficulty of access.
	Tungabhadra R.	*Tungabhadra R.* borders the Madras Presidency from Harihar to Kurnool where it joins the Kistna R. Impending irrigation projects may affect the river. It is to be hoped that suitable fish ladders will be provided. The river holds large mahseer and has runs and rapids where sport should be good November to March. Distance from Harihar to Kurnool is about 250 miles and motorable roads give access at Hovanur, Hospet, Kampli, Siruguppa, Rampuram; but it is not known if sport available within reasonable reach of those places. There is said to be malaria at Kampli. A portable boat would be essential. Supplies would have to be taken. From Hospet 12 miles is Balasanski district and 2 marches below is Sovainhulli—a Ferry here.
Mysore State.		In the north the *Tunga* and *Bhadra* rivers rise in the Western Ghats to flow eastwards and meet near Shimoga whence they form the Tungabhadra river. The Bhadra is the better fishing river and affords good sport to the Coffee Estate Planters of the area. Mahseer run to over 30 lbs. Further north is the *Sharavati* river which makes its way via the Gersoppa Falls (830 ft.) to the Arabian Sea. It holds mahseer up to at least 20 lbs. Recent Hydro-Electric works may have affected the fishing above the Falls. To the south the *Cauvery* river, its sources in the mountains of Coorg, having added to its waters many streams rising in the Western Ghats, leaves the State 30 miles below the Sivasamudram Falls. It is joined by its largest affluent, the *Kabbani* River, a few miles below Mysore City. Mahseer in the Cauvery and Kabbani run to over 100 lbs.* The

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* In May 1946 Mr. Van Ingen caught one of 120 lbs.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Mysore State—(*contd.*)		record fish for India (119 lbs.) came from the Cauvery some 14 miles below Mysore City and the next largest (110 lbs.) from the Kabbani in its higher reaches. These large fish are mostly taken on balls of ragi paste. Where there are rocks and rapids fish up to 40/50 lbs. have been taken on spoon; but other large mahseer have been caught on both live and dead bait, and on spoons.
	Lakes.	The *Krishnarajasagara Lake* formed by a Dam across the Cauvery 11 miles above Seringapatam holds many monster mahseer which are very difficult to catch in such a deep and extensive sheet of water. The *Vanivilas Sagar* is another large Lake. It is west of Hiriyur and a hundred miles north west of Bangalore. There are other large Lakes and Tanks in all of which use of portable boats is essential to success. The State is well served by a number of motorable and other road giving access to the lakes and rivers of the country.

AVAILABILITY OF GAME FISHING FACILITIES IN MYSORE STATE.

(*Information supplied by the Fisheries Office, Mysore State*).

DISTRICT.	RIVERS, LAKES, OR PLACE.	REMARKS.
Mysore State.	Cauvery R.	*Cauvery R.* Seringapatam 10 miles from Mysore and 78 miles from Bangalore reached by rail and motorable road. A good T. B. with servants is available. Surrounding Seringapatam are a few good pools for Mahseer and other carps. Doddinamadu on the 4th mile stone from Seringapatam on the way to Bluff. Two pools here are famous as containing record size Mahseers. Coracles are available. Bommanathittu, 5 miles from Seringapatam up-stream, on the way to Krishnarajasagar reservoir. Close by is a Bird Sanctuary and the pools within about 2 miles are good for Mahseer, Labeo, Carnatic carp and *Barbus dubius.* Usually baiting is practised in this spot. Coracle is available. Mudukthore, this place is 28 miles from Mysore on the way to Bluff or Shivasamudram. There is a small T. B. in Talkad, 2 miles below along the river course. The large pool formed above the weir

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Mysore State—(*contd.*)	Cauvery R.—(*contd.*)	offers a very good baiting for Mahseer and other carps. Area covered by the pool is more than 4 miles along the river. Boats are essential though coracles may be made available. Shivasamudram or Bluff, this is where the Cauvery leaves the Mysore plateau by means of two falls. Hydro-electric power generating station is situated close by and the place can be reached both from Bangalore and Mysore by road, or up to Maddur by rail and thence by bus. Spinning may be done in the rapids above. Pools below the falls contain good catfishes like Silundia *Mystus aor*, and Mahseers. A collapsible boat will be essential in the pools and rapids below. Mekedatu. This is perhaps the most unfrequented fishing spot comparatively unknown to the anglers. It is reached via Kankanahalli, 30 miles from Bangalore by road and another 22 miles from Kankanahalli by road. A total of 52 miles negotiable during hot months only. Otherwise the motor road from Bangalore to Channapatam on the Mysore road has to be used and the road to Satnur and Aladahalli a distance of about 62 miles has to be covered from Bangalore. There is a small T. B. and coracles are available. The rapids and the large pools contain record size Mahseers. From what has been gathered from the local fishermen, it is evident that the large pools and the rapids have very old and large inhabitants more particularly mahseers and catfishes. Coracle is availabe. Both spinning and baiting may be practised very successfully.
	Krishnarajasagar Lake.	Krishnarajasagar, the lake is formed by a large dam across the Cauvery. It is reached from Mysore either by train or by road, (12 miles). Good Travellers' bungalow available as well as a European Hotel run by the Government of Mysore. Angling is good only in the rapids below the dam in the waste-weir and the river course. Baiting may be done on the quieter pools along the river or in the reservoir itself. Rapids below offer good spinning. But the reservoir itself is not very good as it is too deep and game fishing is not tried successfully on it so far. Two miles below in a pool formed by another small

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Mysore State—(*contd.*)	Krishnarajasagar Lake—(*contd.*)	weir across the river good angling for Mahseer as well as other carps and some catfishes like Wallago is available. The back washes of the reservoir in the river course near about Krishnarajnagar 18 miles by rail, and 22 miles by road, baiting may be practised successfully for Mahseer, Labeo, Carnatic carp etc. Boats are available and coracles may also be arranged. *Krishnaraja nagar* is two miles from the angling grounds possessing a good T. B. with servants. Chunchankatte, 10 miles from Krishnarajnagar, this can be reached by a motorable road. A small T. B. is available. The rapids and pools below the weir are good for spinning and baiting and very good Mahseer may be had at all times. 6 miles above along the road is another place, Hansoge which is also good for angling and could be visited from Chunchankatte. 25 miles from Krishnarajnagar and about 16 miles from this place is Ramanathpur where a Temple Sanctuary is interesting as it shelters almost all the carps of the Cauvery. They are accustomed to human company and are very tame. Fishes ranging up to 80 lbs. (Mahseers) are seen in the pool. Angling of any kind is prohibited for about a mile surrounding this area. There is a good T. B. also in this place.
	Kabbani R.	Kakankote. 48 miles from Mysore. Very good mahseer is available surrounding this area. The pools are 'palace game preserves'. Other pools not set apart are also good and may be tried successfully as the Kabbani teems with large mahseer. The river 12 miles below may be tried in the deeper pools near about Sargur. There is a good T. B. in Heggadadevankote, about 15 miles from Kakankote downstream. The pools from Heggadadevankote are between 6 to 8 miles and are reached by roads. Probably the good fishing season in this area is between October and December when mahseers breed in the pools of these head waters of the Kabbani.
Shimoga	Thunga and the Bhadra.	Shimoga. This town is reached by rail from Bangalore towards the northwest of the State. Also a good road from Bangalore up to Honnavar in North Canara which passes through Shimoga. Sacrebyle, 9

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Shimoga—(*contd.*)	Thunga and the Bhadra—(*contd.*)	miles from Shimoga has good number of pools and abounds in mahseer, *Barbus neilli, Labeo fimbriatus* and several catfishes like *Mystus aor, Psendotropius, Bagarius.* A Small T. B. available at Sacrebyle (as well as a good T. B. in Shimoga itself provided with servants). Other pools along the river may be tried near about Sacrebyle and a collapsible boat may be very useful as there are no locally available coracles or boats. Occasionally an eel or two are also hauled.
	Thungabhadra R.	Honnali, 24 miles from Shimoga by road possesses a few good pools where mahseer, *B. neilli* and other carps and catfishes may be successfully angled for. There is a good T. B. here on the bank of the river.
	Sharavathi R.	North-west of Shimoga District is this drainage which is almost unknown for anglers. Mahseers, and other carps like *B. neilli* and Labeos are available. The camping facilities available are at Gersoppa or Jog Falls itself which is going to become a Hydro-electric generating station. There are good travellers' bungalows for staying and angling may be tried both above the Falls and below. A collapsible boat is very essential. Talguppa has a good T. B., 12 miles from Jog Falls and could be reached from pools of the river, 5 miles distance by good motorable road. Angling has not been tried here properly by anyone though the local records show the occurrence of game fishes in large numbers.
	Sulekere Tank.	*Sulekere Tank.* 26 miles from Bhadravathi and 36 miles from Shimoga by road, this place has a good T. B. and angling for small carps up to 12 lbs. as well as catfishes up to 30 lbs. may be done profitably. There is no facility for boats or coracles nearby. Lot of butterfish (*Callichrous*) and occasional eel offer good variety.
Chitaldrug.	Vanivilas Sagar.	*Vanivilas Sagar* :—102 miles from Bangalore in Bangalore—Bellary road, turning west at Hiriyur. There is a good T. B. and an Inspection Lodge. This large lake is not very well stocked with good varieties of fish and it is not placed very conveniently for an angler. This lake is the second biggest in Mysore. There is good boating and a steam launch. Mahseers, *B. neilli* are recorded occasionally and several large catfishes and carps up

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Western Ghats.		to 15 lbs. are usually common. Eels are also caught now and then.
South Kanara. (for N. Kanara see under Bombay).	Holadi R. Sitanadi R. Swarnanadi R. Gurpur R. Netravati R. Gundayahole R. Payaswani R. Valarpattanam R.	All rivers having sources in the Western Ghats and flowing westwards into the Arabian Sea hold mahseer in their hilly portions. Ordinarily size will not be above 15 lbs. Except where within reach of motorable roads the streams are not easy to get at. Apart from such notes as are available and given below, the interested angler can obtain information as to roads, accommodation, and rivers from the Road Map of India, and Survey of India Maps. 'The Rod in India' by H. S. Thomas, 2nd Edition, 1881; and 'The Mighty Mahseer' by Skene Dhu, 1906; should also be referred to. Mahseer in all these rivers take spoon bait, in some of them they will accept no other bait, and in some they will take fly. In some of the streams the less glittering spoons of frosted silver finish do better than ordinary bright spoons.
South Kanara.	Holadi. R.	*Holadi R.* this river may be fishable from the Hulikal-Hosangadi road which runs parallel, and a few miles from it, after it leaves the Mysore State. No information is available.
	Sitanadi R.	*Sitanadi R.* is crossed by the Agumbi Ghat road (motorable, Buses ply) between Someshwar and Hebri east and south of which is another stream.
	Swarnanadi R.	*Swarnanadi R.* crossed by the Hobri-Karkal road and in its upper reaches by minor roads at Mala and Miyar. No information is available.
	Gurpur R	*Gurpur R.* crossed in several places, Yenur, Marur and, to the north Naravi, by major and minor roads. No information is available.
	Natravati R.	*Natravati R.* enter sea at Mangalore. Has a number of large hill tributaries. A large tributary with many hill streams joins the main river at Uppinangadi. On the northern streams are Charmadi and Neriya mentioned by Thomas (the former on the Mudgiri—Mangalore Ghat road) and on the eastern stream is Shisla, accessible by cart track (3 miles) from Shiradi. The other main tributary also joins in at Uppinangadi. It is the Kamaradhari and has two branches.

Districts.	Rivers & Tanks.	Remarks.
South Kanara—(*contd.*)	Natravati R. —(*contd.*)	The Gundayable comes from near Manjarabad and has the Hassan-Sakleshpur-Mangalore Ghat road alongside it for about 20 miles, Buses run. Stay night at Manjarabad Club (road branches here for bisole on upper reaches of Kamaradhari which can also be got at from where the above mentioned ghat road joins with it 20 miles below Shoradi.) next day take bus and go stay Kumphulla, D.B. Fish accessible parts of river from there. Then go Gungaya where is old Forest Shed now used as a cow shed. Camp. Five miles further down is Shiradi, L.F.R.H. at mile 53 from Mangalore. Good spot 1 mile above bungalow also below. Four miles from bungalow cart track for Shisla turns off to the right. Nowhere to stay, river full of fish. Period for these waters middle September onwards. Malaria precautions necessary. See also Notes by Skene Dhu at pages 219 & 220 of his book.
	Payaswani R. add. A. F. R. H? at Parappa down-stream about 4 miles from Jalsur. Malaria.	Good looking water at Sulya which is 33 from Mercara and 52 from Mangalore on the Ghat road between these places. At Sulya from F.R.H. and from here towards Mercara the road runs within reach of the river for about 20 miles. No information available but fishing should be good. 5 miles up and down available at Sulya.
Malabar. (See also p. 236)	Vallarpattanam, R. Beypur R. Palanted R. & Head waters of Kabani R. flowing East.	General remarks as for South Kanara. The Vallarpattanam R. becomes, higher up, the Valiyapuzha which rises in Coorg. A F.R.H. at Makut inside Coorg and a P.W.D. Bungalow at Kutupoya in Malabar. These only two miles apart. Other side of river from Kutupoya is Portland Rubber Estate. Ghat road runs for eight miles within reach of the river until Iritti where it is joined by the Aralam Puzha, a large stream with many hilly affluents. 4 miles up stream village Aralam.
	Beypur R.	*Beypur R.* Upper reaches fanning out in the valleys are accessible in some places from the Calicut-Gudalur road. Mahseer up to 15 lbs.

9. PUNJAB AND NORTH WEST FRONTIER PROVINCE AND BALUCHISTAN.

Abbotabad.	Siran R.	*Siran R.* From Harriapur Station, then 7 miles to Thapla fishing is good from the junction of the

Districts.	Rivers & Tanks.	Remarks.
Abbotabad—(*contd.*)	Siran R.—(*contd.*)	Dore with Siren down to junction with Indus. Bala is another good place.
	Kalapani R.	*Kalapani R.* Was stocked with trout (fario) years ago, but have since disappeard I understand.
	Dore R.	*Dore R.* Crossed near Sultanpore on Hassan-Abdul-Abbotabad road by a large bridge, but is a poor stream with very small fish.
Ambala.	Jumna R.	*Jumna R.* The only water is at the Head works of the Jumna Canal at Tajuwallah, and Dadupore. Served with a good motor road, or by railway to Jagadri station 12 miles away. The canal falls all hold Mahseer as far down as Karnal.
Baluchistan.	Rakni R.	*Rakni R.* Approached by Frontier road from D. G. Khan to Peshin, through Loralai. Best water between Mat and Rakni.
	Anambar R.	*Anambar R.* The best fishing is between Shadiani and Missi and Misri kach 20 miles from Loralai.
	Bolan R.	*Bolan R.* Train to Sibi or Nari bank and make for Kirth Rest House or Wundalami R. H. an easy ride, Fish are all Mahseer under 15 lbs.
Bannu.	Kurrum R.	*Kurrum R.* Near Bannu and below the Kurrum Post small fish of 2 and 3 lbs. can be caught, but the best fishing is in the upper reaches above Thal extending up to Parchinar where fish of 5 and 6 lbs. have been caught.
	Tochi R.	*Tochi R.* Good sport can be had with small Mahseer near Saidgi and Shinki, I have caught them as high as Edak but it is unfriendly country and hardly worth the risk unless under pickets.
Campbellpore	Hurroo R.	*Hurroo R.* Mahseer are to be had in some good rapids 10 miles out, but the best fishing is at the junction with the Indus.
	Kabul R.	The Kabul R. also join the Indus near here and is reported to hole larger fish.
Ferozepore.	Sutlej R.	*Sutlej R.* Sluices & pool below Sutlej Dam on Ferozepore-Lahore road (6 m. from Ferozepore & 44 from Lahore). *Butchwa* on fly (jungle cock & silver) or any lake size fly with silver tinsel about it, also small fly-spoon. *Mulley.* not uncommon and frequently taken. *Seetul,* large numbers are seen and some are caught when trolling big pools below the bridge dam.

Districts.	Rivers & Tanks.	Remarks.
Ferozepore—(*contd.*)		*Mahseer* are present. No information as to size there is an excellent fish-ladder. Plenty of rohu and other fish many turtle and a few garial. For all the fishing boat almost essential and can be readily obtained from local fishermen.
Jhelum.	Jhelum R.	See under Tangrote.
Kashmir.		Trout are to be had but the subject has been dealt with so thoroughly in books already in print that it is unnecessary to enumerate the rivers and localities here. A book on the rules with general information is published by the State and is obtainable for 8 annas. There are besides a number of agencies who make all arrangements for the new comer.
Kohat.	Toi R.	Small Mahseer may be had near Dobah and below.
Kulu.	Bias R.	To the intending visitor to Kulu no better guide than T. Tyson's book 'Fishing in Kulu' could be recommended. It is published by the Civil and Military Gazette Lahore. It has maps and all the information necessary.
Lahore.	Ravi R.	Butchwa and the commoner fishes can be had near the Bridges. For mahseer, journeys must be made to one of the many places listed.
	Tanks.	A number of tanks have been stocked with Labeo by Government for information apply to the Director of Fisheries, who will give up to date information.
Loralai.	Rakni R.	See note under Baluchistan.
Murree.	Mahl R.	This river can be reached in two easy marches. Distance 24 miles to Dhalkot via Thanda. It joins the Jhelum at this point, much up-stream it is indifferent fishing with small fish. When the Jhelum is in flood and banks up the mouth of the Mahl, big fish are to be had by both spinning and on frog. See further notes on this river under Tangrot.
Pathankote.	Ravi R.	Madhojur 8 miles away is at the Headworks of the Lower Bari Dhob Canal off the Ravi R. best fishing is above the wier.
Peshawar.	Swat R.	28 miles from Cantonments is Fort Abazai, built on the river. Good fish are recorded from here, in the 'Anglers Hand Book' but times may have changed.
Quetta.	Bolan R.	See under Balauchistan.
Rawal-Pindi.	Sohan R. Korung & Chiblat R.	All within easy reach of Cantonments, and were once protected by a Fishing Club, local information is necessary or if the Club log book

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Sialkote.		is available reference to notes therein will be of help.
	Chenab R.	The Chenab takes in two or three streams, the junctions of which are all reported to be good. Trolling in the deep pools has also met with success. The Jammu-Tewari? Bhab-Nala? and Khano Bhao Nala.
Simla Hills.	Giri R.	This river can be reached from Solan, from where it is 10 miles to the junction of Giri and Ashai stream, or from Salogra Ry. Stn. only 7 miles from the same junction. If planning a long holiday—Fish from here to the junction, with the Jumna about 50 miles of good fishing water, with innumerable tributaries joining in.
	Sutlej R.	This river runs north of Simla, and provides power and water and is an easy days march. For details of good fishing places local enquiries should be made.
	Bias R.	On the road to Kulu and in Mandi State some of the streams are stocked with trout. For details see under Kulu.
Tangrote.	Jhelum & Poonch.	This is probably the most celebrated spot for fishing in the Punjab and needs little introduction. It is reached from Dina Ry. Stn. then by road 16 miles or from Jhelum 23 miles by road or river. The Bungalow has a Visitors Fishing Book full of most interesting notes. Trips from Poonch can also be undertaken and are an interesting and popular approach.

This concludes these brief notes on fishing in the Punjab, there are of course scores of other places about which little is written or known, except to a select few who guard them as secret.

10. UNITED PROVINCES AND DELHI.

Allahabad.	Jumna & Ganges.	All the commoner fish are to be taken, Butchwa, Silund, and W. Attu, etc. The Jumna has much the best water of these two sacred rivers at this revered junction. It carries the greater volume of water being fed by the Central Indian Rivers. The best places to fish for Butchwa are undoubtedly around the piers of the Railway Bridge in the broken water, and in the swirls near the banks from the water works down to the Junction. The best time is from 10 a.m. to 4 p.m. when the water is clear, and at the changing of the seasons, and hot weather.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Allahabad—(*contd.*)	Jumna and Ganges —(*contd.*)	*Bait.* Fly-spoon, Fly, Mole cricket or small fish will all take Butchwa, but for Silund a slowly spun bait 4 to 6 inches long is the best, or a 'Plug' may be successful. The Ganges is indifferent, though fish are visible near the Railway Bridge. It has very little water in the best Season, being drained for irrigation by Canals.
	Tons.	Small Mahseer are taken on Fly-spoon both below and above the bridge on the Rewa Road from two to four miles. Best season is after the Rains when the river clears, fish up to 10 lbs. have been caught. Fishing is good from Lohaa to Korhar about 16 miles of water.
	MacPherson Lakes.	These lakes are in the Cantonments and are well stocked with Labeo, Catla, and Mirgil. Evidence of their popularity is seen by the number of Machans erected. Fishing permits are issued by the E.O. and the Chowkidar will erect a Machan for Rs. 10/-. A Book of catches is kept by the Chowkidar and makes interesting reading. Fish are caught all the year round, the best bags are registered in September and October and part of November : Catla of 60 lbs. have been taken and Rohu of over 30 lbs. There are also tanks within a radius of 20 miles of the town, that fish well.
	Balan R.	A small river in the South of the District holds small Mahseer and B. Bola. Take road to Kuraon then follow the Mirzapur road to where it crosses. Good water to Mando village down stream. This is from a friend. The Balan also fishes well in the Mirzapur district. Places mentioned in the Anglers Handbook are Buroundeth 25 miles down the Rewa Road a P.W.D. Bungalow, also a bridge. The River is 300 yards away, and fishing is good to Koolsara.
Almora.	Kosi R.	The Kosi is crossed on the way from Ranikhet, but it is a small stream here and the best fishing is lower down and above Kairhna, though it is not really good until it enters Reserve Forest one march below Kairhna, from here down to where it comes out of the hills is all good. Further west is the W. Ramgunga an excellent river and easily approached from Ranikhet,

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Almora—(*contd.*)	Kosi R.—(*contd.*)	or from Ramnagar on the O & T. Railway. But for the best fishing in this District we must look East to the Surju and East Ramgunga.
	Surju R.	The water from Kapkot (D. B. Bungalow) 14 miles above Bagashwar on the Pindari Glacier road to two marches from Almora down to Rameshwar where it joins the Ramganga is all good water and fairly well provided with Rest Houses. There are some imposing Gorges along this stretch of river, and fishing is somewhat restricted, though they are worth any amount of trouble as they hold huge fish of 50 and 60 lbs. Kit must be carried by coolie, as the pony track leaves the river in places, and good water is missed out. Bait. This is a chilwa or dead bait river, and gives far better results than spoon, except for the light work with Fly-spoon. The best water is lower down and I would recommend making for Upper Shera Ghat 29 miles from Almora. From here down to Rameshwar is all good water taking in the R. Ramganga here it flows on for another 6 miles to join the Kali at Pachashwar, making a wonderful junction and which I think is the best water in Kumaon. There are monster fish here and it is not unusual to be running fish all day. The best time is March and April, May is a bit late, besides it gets oppressively hot.
	East Ramgunga.	This river is still further East and runs on a parallel course, more or less from Tajam to Rameshwar with the Surju. It is a river of deep un-approachable gorges, which has to be approached in certain portions and only after long marches and much climbing. It can be approached (1) by crossing the Samapass above Kapkot, and working down the river to Rameshwar to the Junction with the Surju. I have done it once, but it proved more an adventure than successful fishing. A boat to work down through these gorges would be an experience well worth trying, there is certainly no other way of doing it. It holds enormous fish, (I have a belly scale of a fish I foul-hooked in this river that is the size of the palm of the

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Almora—(*contd.*)		hand). It is a much faster and larger river than the Surju.
	Gori R.	Still further East is the Gori a raging torrent almost all the way down to its junction with the Kali. It offers wild scenery and good shooting, but has proved a disappointing river to fish for mahseer. I feel sure it would, with its many feeders, make an excellent Trout river.
	Gonah Lake.	Is not in the Almora District but in Tehri Garhwal. One of the easiest ways to it is from Almora so I have included it here. It has an abundance of trout, and the angler is amply repaid for the long and arduous 'trek' of getting there in 7 or 8 marches.
Baraich.	Sarda R.	Katernian Ghat on O & T. Railway is on the bank of the River fish have been taken both above to the Nepal frontier and also a few miles down, small Mahseer and B. Bola. The best fishing is to be had in Nepal to a place called Chisapani 32 miles inside. But for this, special permission must first be obtained and this is not easy. The arrangements for getting supplies and transport are a further difficulty, as it is wild country with very poor roads.
	Surju & Rapti.	These two rivers in the North East of the District should be good but the best water is in Nepal.
Benares.	Ganges R.	Butchwa and other predacious fish can sometimes be caught by the keen angler near the Pontoon and Railway Bridge, or if one wishes to catch the foul feeders, the outlet of the sewage drain below the Railway Bridge worm will provide '*sport*'.
	Tanks.	The Benares State have some nice tanks well stocked with Rohu, but permission must be obtained. There is also a very pretty Bungalow at the Reservoir at Naini 20 miles out, below the dam is a pool full of elusive fish which is protected by the State. It would be well worth a visit in October after the water had cleared or after baiting with gram.
Dehra Dun.	Ganges. Song & Suswa & Asan Rivers.	All but the first named are protected for part of their length by the D.D. Fishing Association from whose books full details can be obtained. The Ganges is best at Lachmanjhoola, Rikkikash, Tajuwallah? and at Hardwar, but care must be taken to avoid Temples and Sacred ghats etc. in order to avoid any chance of unpleasantness.

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Dehra Dun—(*contd.*)	Ganges Canal.	This information could be obtained from the Collector of Dehra Dun or the local Canal Authorities. The falls below Hardwar are at approximately 3-mile intervals, and fish well at times, I have had excellent sport at Patri Falls. A key for the road gates must be obtained from the R.E. in charge, who is as often as not himself a fisherman and would be helpful if called upon. The falls used to fish well as far as Delhi but the Hydro Electric grids have spoilt falls from an Anglers point of view.
	Jumna R.	*Jumna R.* In the west of the Doon is the Jumna, and with the Asun affords good fishing. Full details are obtainable locally and through the Association.
Delhi.	Jumna R.	*Jumna R.* At Okhla-14 miles excellent fishing can be had with Mahseer and the predacious fish, when a fish run is on and the small fish have collected. Silund if on the feed will give grand sport. Some good sport has been had at the overflow. It is necessary to have someone on the spot to send information of the fish running, generally just before and after the Monsoon.
	Ganges Canal.	*Ganges Canal.* The falls at Dashna were good but are probably spoilt, with those in the Meerut District, by the many grids erected.
	Roshnara Tank.	*Roshnara Tank* is well stocked with Rohu and is well known. There are besides a number of old tanks in and around the old City.
Gorakhpore.	Gandak R.	This river borders on the East of the District and although the Malars at Tirbhani catch fish of 20 lbs. and over, I have only heard of small Mahseer being taken on spinning bait. There are few rapids and it has been little tried.
	Tanks.	A poor station from the Anglers' point of view, though there are a few tanks which hold *Labeo.* Butchwa can be had in the small streams draining the District at pontoon bridges, junctions etc. while the large lakes hold Murrel in large quantities.
Hardwar.	Ganges	See under Dehra Dun.
Jhansi.	Betwa R.	*Betwa R.* Mahseer and trout (B. Bola) can be had down the Nowgong Road. 7½ miles from Jhansi. Paricha 15 miles down the Cawnpore road is probably the best water near at hand. There are other places but off the beaten track and at greater distances. Other

DISTRICTS.	RIVERS & TANKS.	REMARKS.
Jhansi—(*contd.*)	Betwa R.—(*contd.*)	small streams worth a trial with light tackle during or just after the Monsoon are the Barbari, Pahuj, and Dhurari Nallahas, all within easy reach of the town and served by good roads.
	Burwa Sagar Tank.	*Burwa Sagar Tank* 13 miles out affords the tank angler with all he desires.
Landsdowne.	Nayar R.	*Nayar R.* A tributary of the Ganges. Rail to Kotdwara and make for Bang-Ghat 29 miles where there is good water all the way down to the junction, fish of 30 lbs. have been taken.
Lucknow.	Gomti R.	*Gomti R.* Lucknow has no fishing to write about except perhaps a few butchwa in the Gomti and Rohu in tanks dotted about, but it is well situated, and one can get to good water in a nights journey.—The Sarda at Tanakhpore, the Girwa at Kauriala on O & T. Railway, Betwa at Jhansi.
Meerut.	Ganges Canal.	The canal has a number of falls at easy distance from Cannt. (see remarks under Delhi) Fishing with atta paste at the cattle crossings and drinking places sometimes provides good sport.
	Hinden R.	Hinden River is very popular with Indian Anglers who get good fish of the pariah types, but details are lacking.
	Tanks.	The only tank I know of is 7½ miles out on the Hapur Road, it holds *Labeo.*
Naini Tal.	Gola, & Kosi. R.	The *Gola* at Ranibagh, and *Kosi* at Kairhna and below both give sport if hit off at the right time.
	Nandhaur R.	*Nandhaur R.* Runs through Reserved Forest it is situated 12 miles East of Haldwani on O & T. Ry. It is connected by motor road, and has F. R. Houses. The best fishing is above, where fish of 10 pounds or more can be had on fly-spoon. Camp at a chowki called Selakul 5 miles from Chorgalia. Best seasons are Feb/March and after the rains.
	Lakes.	The lakes at Sathtal Naukatia and Bhimtal are well known, and easy to get to from either Naini Tal or Bhowali. It is pretty fishing with fly, the fish seldom run above two lbs. and are poor fighters. Kurpa Tal on the Kaladungi Road is also worth a trial, but Nainital is disappointing, and the fish are dying off yearly.
Philibhit.	Sarda R.	*Sarda R.* Tanakhpore is within easy reach, and has some good water above and up to the Puni-

DISTRICTS.	RIVERS & TANKS.	REMARKS.
		gari gorge above the Boom at Barhamdfo. Opposite the Forest Rest H. and down to Bombasa if fishes well in the hot months and before the snow water comes down. The canal itself should hold fish though I have no first hand information of anyone fishing it or catching anything.
Saharanpore.	Jumna R.	*Jumna R.* There is good fishing to be had in the North of the District, in the many streams that flow into the Jumna, or Ganges. Notes and Names of places are not available to include here.
Tanakhpore.	Ladhya R.	*Ladhya R.* Though in the Almora District, it is best approached from Tanakpore, 7 miles up the Loharghat Road, the Ladhya is crossed at Chalti. From here to its junction with the Sarda at Chuka—a distance of 14 miles—is all excellent water for B. Bola and Mahseer up to 15 pounds. Best season is Oct/Nov. or just after the monsoon.

THE EARLY STAGES OF INDIAN LEPIDOPTERA.

BY

D. G. SEVASTOPULO, F.R.E.S.

PART XV.

(*Continued from Vol.* xlvi, *p.* 69.)

RHOPALOCERA.

PIERIDAE.

Delias berinda Moore, *boyleae* Btlr.

I can find no constant difference between the pupa of this subspecies and that of the nominotypical one (1941, mihi, *Journ. Bomb. Nat. Hist. Soc.*, xlii, 748). A few had a broad white marginal band on the wing cases, leaving only a submarginal olive-brown blotch between it and the central white triangular mark.

Pupa usually found in small groups of seven or eight on the upperside of twigs or leaves of medium height bushes. Presumably the larvae drop from their food-plant and spin up below.

Described from a number of pupae found at Tukdah (5,000 ft.

Darjeeling District) 10-v-44, from one of which a male emerged 14-v-44.

DANAIDAE.

Euploea mulciber Cr., *mulciber.*

Moore, *Lep. Ind.*, i, 100, pl. 35, fig. 1. 1890-92.
Bingham, *Fauna Brit. Ind.,* Butterflies, i, 45. 1905.

1st instar—Head black. Body greenish yellow with faint grey transverse stripes. Legs and prolegs black. Tentaculae indicated by raised blackish dots.

Half grown larva—Head black. 1st somite with a subdorsal black spot. Body white transversely banded with olive, anterior and posterior somites and a lateral stripe yellow. 2nd, 3rd, 5th and 11th somites with short subdorsal tentaculae. Legs and prolegs black.

Final instar—Head black with two white rings, the inner one triangular. 1st somite yellow with a purple black transverse band. 2nd to 11th somites white with two transverse black bands on each somite ending above the spiracles, the posterior band edged behind with purplish, which continues to the sublateral area, and two fine black lines between each somite. An interrupted orange spiracular stripe, below which is a series of triangular white spots. A purple black sublateral stripe. 12th somite tinged with orange posteriorly. Venter purplish with a purple black lateral stripe. Legs black. Prolegs black ringed with yellowish olive. Anal flap and claspers black. 2nd, 3rd, 5th and 11th somites with subdorsal tentaculae, purple at base and blackish above, the anterior two pairs longest.

Pupa suspended by the cremaster. Brilliantly gilded except a ventral streak below the head, the antenna sheaths, a discal streak and marginal band on the wing cases, the median portion of the thorax, a dorsal band on the 4th abdominal somite and a subdorsal and lateral stripe on the abdomen, which are purple buff. Anal somite and cremaster black. Shape rounded, the thorax and abdomen domed.

Described from larvae found at Tukdah (5,000 ft. Darjeeling District), one of which pupated 18-vi-44 and a male emerged 30-vi-44.

Bingham quotes the following description by Moore:—'Larva cylindrical, with four pairs of long fleshy subdorsal filaments which have pink bases and black tips, three pairs being on the anterior segments and the fourth pair on the 12th segment. Body pinkish white with lateral yellow blotches, the segments each divided by a black line and anteriorly bordered by a narrow transverse pink band and purple-brown stripes; spiracles black; head with a dark red stripe in front and one on each side; fore legs black, middle and hind legs black ringed with pink. (Larva of the Javan form, *E. claudia.*) Pupa short, thick across the middle; thorax concave behind; abdominal segments dorsally convex, metallic golden-brown with darker brown anterior stripe.'

SATYRIDAE.

Lethe rohria F., *rohria*.

1st instar—Head yellow green, slightly bifid above, with a few black hairs. Body bluer green, the secondary segmental divisions whitish, a few black hairs visible under a lens. Anal somite bifid.

2nd instar—Head green, rounded and surmounted above by two points close together, and clothed with black pubescence. Body green, under a lens covered with minute white points and colourless pubescence. Anal somite divided into two pink processes.

3rd instar—Similar. The cephalic points pink. Body bluer green with a dark dorsal stripe and a white subdorsal line. Anal somite produced into a triangular point, the apex bifid.

4th instar—Head green, heart-shaped, the apex pink and slightly bifid, a yellowish line posteriorly joining the subdorsal body stripe. Body blue green, a bluish dorsal stripe edged with whitish, a yellow subdorsal line with prominent yellow spots on it on somites 5 to 9, those on 6 and 7 largest. A green lateral line, edged above and below with white, and a white sublateral line. Anal somite produced into a long triangular process, bifid at the tip. Venter, legs and prolegs green. Clothed with short colourless pubescence.

5th (final) instar—Similar. In some examples the yellow subdorsal spots centred with orange.

Pupa suspended by the cremaster. Greyish green, very finely streaked with fuscous. A fuscous dorsal stripe, abdomen with a subdorsal and ventro-lateral fuscous stripe in addition, the subdorsal stripe enclosing white dots on 2nd to 6th abdominal somites. Wing cases with a white line bordered above with fuscous along the upper edge. Shape—head truncate, thorax slightly keeled, wing cases not dilated.

Food-plant—Grasses.

Described from larvae found at Tukdah (5,000 ft. Darjeeling District), one of which pupated 5-vii-44 and a female emerged 12-vii-44.

Moore (*Lep. Ind.*, i, 261, pl. 84, figs. 1, 1a-1d. 1890-92) figures and describes the larva of the subspecies *nilgiriensis* Guer., and also figures it, without a description, in *Lep. Ceyl.*, iii, pl. 210, fig. 4, 1880. Bingham (*Fauna Brit. Ind.*, Butterflies, i, 81. 1905.) quotes this description as follows:—'Larva fusiform, elongated; head conical, the vertex being prolonged to an acute point projecting forward and anal segment also prolonged to a point projecting backwards. Colour green, with darker dorsal and lateral stripes and a slight ochreous subdorsal stripe.'

Lethe sidonis Hew., sidonis.

Head green, produced above into two pink points with a white line down the back joining the subdorsal body line. Body green, a blue dorsal stripe edged with whitish, a white subdorsal and whitish lateral line, both edged above with dark green, and a white sublateral line. Spiracles white. Venter, legs and prolegs green. Anal somite produced into a long triangular process, bifid at the end.

Pupa with the head truncate and expanded into two slight points fronto-laterally. Thorax with an erect median point. Colour grass green, a cream line along the upper edge of the wing cases and continued round the head. The thoracic point cream. Thorax with a subdorsal series of minute cream specks. Abdomen with two dorsal, a subdorsal and lateral series of two cream specks per somite, a slightly darker green line between the two dorsal series and between the dorsal and subdorsal. Wing cases streaked with fuscous. Suspended by the cremaster.

Food-plant—Grasses.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 31-v-44, pupated 4-vi-44 and a male emerged 16-vi-44.

Lethe verma Koll., *sintica* Fruhs.

Ovum—Spherical, the base flattened. Very pale blue, almost white. Surface unsculptured. Laid singly on blades of grass.

1st instar—Head black, hairy, very slightly bifid above. Body white on hatching, becoming green after feeding, with a few short black hairs. Anal somite slightly bifid.

2nd instar—Head green, produced above into two points, with a black lateral line from apex of points. Body green with traces of a whitish subdorsal line and a darker dorsal stripe. Anal somite produced into two points.

3rd instar—Similar, but the anal somite produced into a triangular process, bifid at the tip.

4th instar—Similar to final.

5th (final) instar—Head green, produced above into two long pink processes tipped with black, a double blackish lateral stripe from the base of the processes and a white line down the back. Body apple green, a blue-green dorsal stripe edged with yellow, a zig-zag darker green subdorsal line edged below with yellow, most marked on the 6th and 7th somites, a zig-zag green lateral line and a straight white sublateral. Spiracles dark red. The whole body minutely shagreened with yellow points. Legs, prolegs and venter green. Anal somite produced into two long points held close together, pale blue-green shagreened with white. One example had dark red brown streaks above the yellow on the 6th and 7th somites.

Pupa suspended by the cremaster. Head produced into two large frontal points; thorax slightly keeled; abdomen rounded. Colour yellow green, abdomen with a dorsal, subdorsal, lateral, spiracular and sub-spiracular darker green line, most noticeable intersegmentally, the subdorsal and the spiracular lines edged below with yellow and a zig-zag yellowish line between the dorsal and subdorsal lines. Wing cases with two indistinct fuscous stripes.

Food-plant—Grasses.

Described from larvae bred from ova found at Tukdah (5,000 ft. Darjeeling District), one of which pupated 26-vi-44 and a female emerged 6-vii-44.

Ypthima sakra Moore, *sakra*.

Ovum—Greenish white, spherical, the base flattened. Surface very minutely pebbled. Laid singly on blades of grass. Hatched on ninth day.

1st instar—Head pale olive brown. Body almost white when first hatched, becoming greener after feeding, with a subdorsal and lateral purple brown line. Clothed with colourless pubescence.

2nd instar—Head buff, divided above. Body greenish, a dark dorsal, subdorsal and lateral line. Clothed with short blackish hair.

3rd instar—Similar. The points of the head proportionately larger. The lateral line purple brown and with a lateral quadrate dark brown spot on the 7th somite.

4th instar—Similar to final.

5th (final) instar—Head square, divided above into two points. Pale buff, an inverted brown V outlining the clypeus, a dark buff stripe down each cheek, and a dark brown stripe from apex of the point to outside the jaws. Body very pale buff, a brown dorsal, a double buff subdorsal, a dark brown lateral and a brown sublateral stripe, all bordered with darker. 3rd somite with a subdorsal black speck, 7th somite with a lateral black spot. Legs, prolegs and venter pinkish buff, the latter with a median brown line. Spiracles black. Clothed with brown pubescence. Anal somite produced into a pair of longish processes.

Pupa with the head truncate and produced into a slight triangular projection fronto-laterally, the base of the wing cases expanded slightly, thorax slightly keeled, abdomen slightly angled at the 4th somite which bears a slightly raised ridge. Colour buff, streaked and speckled with dark brown. Head, a dorsal stripe on the thorax and first four abdominal somites a longitudinal stripe along the upper edge of the wing cases and a transverse band across the 4th abdominal somite dark brown. Wing cases with the central half heavily suffused and streaked with dark brown, and with a submarginal series of dark specks. 5th abdominal somite backwards suffered laterally with dark brown. Suspended by the cremaster from a dry blade of grass.

Food-plant—Grasses.

Described from larvae bred from ova laid by a female caught at Tukdah (5,000 ft. Darjeeling District), one of which pupated 13-vi-44 and a male emerged 26-vi-44.

NYMPHALIDAE.

Limenitis daraxa Dbl. & Hew.

Head green, shagreened with white points, and surrounded by a series of twelve black-pointed spines, the spines largest dorsally and decreasing in size laterally. Body green, shagreened with yellow points, and with a sublateral series of small yellow spines. A dark dorsal and a whitish lateral line. 2nd somite with a large, black-spined, whitish, subdorsal scolus, which turns deep pink before pupation. Anal somite bifid. Legs, prolegs and venter whitish green.

Pupa suspended by the cremaster. Eyes expanded into a laterally projecting spine. Thorax keeled, rising to a backward-directed point. Abdomen with a slight dorsal keel, expanded into a large point on the 3rd and a smaller one on the 8th abdominal somite, where the keel terminates. Meso-thorax with a short black subdorsal spine, 3rd to 5th abdominal somites each with a subdorsal spine. A lateral spine at base of wing cases, the upper edge of which is expanded laterally. Colour green. The dorsal keel and points thereon purple brown, a purple brown subdorsal stripe on the abdomen becoming lateral on the 4th somite. The lateral edge of the wing cases, a line outlining the spine from the eye, and the basal portion of the antenna sheath on the dorsum purple brown. The antenna sheath ventrally yellowish white. A spot over the eye, the pro-thorax, a stripe on the posterior edge of the meso-thorax, the dorsal area, except for the keel on the meta-thorax and abdomen, the expanded dorsal edge of the wing cases, and a lateral blotch on the 3rd to 5th abdominal somites brilliantly gilded. Two purple brown specks on the wing cases, two on the leg sheaths, and a central streak at base of proboscis sheath.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 19-vi-44, pupated 22-vi-44 and a female emerged 2-vii-44.

Pareba vesta F., *vesta*.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xlii, 752. 1941.

Head shining black, hairy, with a pale inverted Y-shaped mark. Body black, the intersegmental areas blotched with dirty whitish, a whitish sublateral line and a cream medio-ventral stripe. Armed with longish, black, branched spines, a subdorsal on the 1st somite, a subdorsal and lateral on the 2nd and 3rd, a subdorsal, lateral and sublateral on the 4th to 11th, and a subdorsal and sublateral on the 12th somite. Legs black. Prolegs black, the feet pinkish. This is a very much darker and dingier form than the one described from Shillong.

Food-plant—Peile (1937, *A Guide to Collecting Butterflies of India*) gives *Debregeasia bicolor* (Urticaceae).

Described from a number of full fed larvae found at Tukdah (5,000 ft. Darjeeling District), one of which pupated 2-v-44 and a male emerged 16-v-44.

ERYCINIDAE.

Zemeros flegyas Cr., *indicus* Fruhs.

Dudgeon, *Proc. A. S. Beng.*, 140. 1890.

Bingham, *Fauna Brit. Ind*, Butterflies, i, 499. 1905.

Ovum spherical, the base flattened. Yellow green. Under a lens clothed with fine hairs. Laid singly on the underside of a leaf of the food-plant. Hatched on the eighth day.

Young larva—Pale green, flattened. The termen scalloped laterally. Clothed with white pubescence.

Adult larva—Head small, green. Body yellow green with a cream dorsal stripe edged with darker green. The lateral area speckled with yellow dots. Shape flattened, outline oval, the edges scalloped and fringed with colourless hair.

Pupa flattened, the head rounded with a central cleft, abdominal somites scalloped laterally. Colour pale green. Three longitudinal blue lines on the pro-thorax. Meso-thorax with a dorsal, subdorsal and lateral blue line which diverge and then join again. Abdomen with a dorsal series of blue spots, a subdorsal blue line and a lateral series of oblique blue lines. Wing cases with a blue line on the upper edge. Formed on a pad of white silk and supported by a girdle.

Food-plant—*Maesa chisia* Don.

Described from a larva bred from ova laid in Tukdah (5,000 ft. Darjeeling District), pupated 9-vi-44 and a female emerged 19-vi-44.

Bingham, quoting Dudgeon, gives the following description:—'Larva adult: length .75 of an inch. Ovate, extremely flattened, inconspicuous. Colour pale green, head and anal segment slightly lighter; all the segments laterally rounded, covered with whitish down, especially at the sides; an indistinct double longitudinal dorsal darker-green line throughout, enclosing a minute orange spot on seventh and eleventh segments; middle segments more than twice as broad as they are long; legs pale green, set well beneath the animal and rather close together. Full grown at the end of March. Feeds on *Maesa montana*. Larva when about to change into the pupal state attaches itself to a patch of silky web, by the last segment, to the underside of a leaf of the food-plant, with the head towards the apex, and is girt about the middle with another web. Pupa length .55 to .70 of an inch. Fusiform, broadest in the middle . . . . anterior end truncate-rounded, distinctly broader than the posterior; the whole pupa flattened and of very slight depth even in the thickest part; the divisions between the segments well-marked; posterior segment bluntly rounded; head also rounded and divided in the middle at the apex into two lobes by a shallow notch . . . . colour bright yellowish green throughout, marked above with rich emerald-green narrow lines arranged in an arabesque-like pattern on the two outer-thirds; a series of round spots along the middle of the back on the abdomen only, and a subdorsal line on either side interrupted at the segmental constrictions. Under surface pale yellowish green throughout, entirely unmarked . . . . The whole surface of the pupa smooth, without any hairs or shagreening whatever.' I did not notice the minute orange spot in any of my larvae, and in my opinion the species is continuous-brooded throughout the summer.

Dodona ouida Moore, *ouida*.

Ovum—A truncated cone, rounded above, the micropyle a dark, sunken spot. Colour bright mauve. Laid in small, regular batches on the underside of a leaf of the food-plant. The ovum is very much more like that of a moth than that of a butterfly.

Adult larva—Head yellow green with black hairs. Body with the 1st somite yellow green, 2nd to 12th somites with an olive green dorsal stripe edged with yellow green, followed by a wide blue, a narrow blue green, a narrow greenish yellow, an olive green and a greenish yellow stripe. Anal somite yellow green. Venter, legs and prolegs pale green. Spiracles white. Subdorsal and sublateral areas sparsely clothed with erect black bristles. Gregarious. Some colonies of larvae are more tinged with green, others more tinged with blue.

Pupa suspended by a girdle and tail pad of white silk. Rounded, the thorax slightly domed, the head rounded in front and divided by a central cleft into two rounded lobes. Colour yellow green, the lobes of the head yellow. A blue dorsal and subdorsal line, the latter terminating on the 4th abdominal somite and continuing as four blue tubercles. Three blue lines on the wing cases. A lateral series of blue spots on the abdomen and traces of a series of blue spots between the dorsal and subdorsal lines.

The larva is very like that of *Abisara fylla* Dbl., described below, and the pupa similar in shape though not in colour. Both larva and pupa differ widely from those of *Dodona adonira* Hew., also described below, and also from the published description of those of *Dodona eugenes* Bates, the only previously published description of the early stages of a *Dodona* that I know.

Food-plant—*Maesa chisia* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 25-v-44, pupated 1-vi-44 and a male emerged 15-vi-44.

Dodona adonira Hew., *adonira*.

Head and body rich green, clothed with short colourless pubescence. Shape tapering to the rear, the anal flap ending in a point. Somites slightly scalloped sublaterally with a fringe of rather longer colourless hair.

Pupa suspended by a girdle and tail pad of white silk. Shape unangled, the head divided into two slight triangular fronto-lateral processes. Colour pale green, the cephalic processes and apex of the abdomen yellow.

Food-plant—*Maesa chisia* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District), 24-v-44, pupated 28-v-44 and a female emerged 10-vi-44.

Abisara fylla Dbl.

Head yellow green with a few black bristly hairs. Body green, 1st somite pale blue with a subdorsal blue black spot. A blue dorsal line, a pale blue spiracular stripe with a darker blue line in it and with a whitish stripe below. 12th somite backwards green throughout. A subdorsal series of groups of four black bristles per somite and a sublateral series of groups of colourless hairs with one or two black ones among them arising from slight tubercles. Venter, legs and prolegs whitish. Spiracles yellow green ringed with black.

Pupa suspended by a girdle and tail pad of white silk. Head rounded, with a slight median cleft dividing it into two frontal lobes. Thorax domed. Abdomen stout and slightly humped. Colour deep lemon yellow thickly speckled with rusty red, ventral surface greenish. A dorsal series of six purple spots on the abdominal somites. Spiracles bright blue.

As mentioned above the larva and pupa of this species are very like those of *Dodona ouida* Moore, they differ widely from the published description of the early stages of *Abisara echerius* Stoll.

Food-plant—*Maesa chisia* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 14-vi-44, pupated 22-vi-44 and a male emerged 4-vii-44.

LYCAENIDAE.

Heliophorus brahma Moore, *brahma*.

Head brown, retractile. Body bright apple green, a darker green dorsal line, a slightly darker green subdorsal and a double lateral line. Clothed with very short colourless pubescence. The usual Lycaenid wood-louse shape.

Pupa yellow green. Abdomen with a purple brown dorsal line and traces of a subdorsal line, a purple brown dorsal blotch on the waist and another on the posterior somites. The thorax and outer margin of the wing cases slightly suffused with purple brown. The purple brown markings vary greatly in extent and intensity. Shape rather stout, the thorax and abdomen domed as usual in Lycaenid pupae, abdomen with a double series of very minute dorsal humps. Slightly pubescent. Formed on a slight mat of white silk on a leaf of the food-plant and held in place by a girdle.

Food-plant—*Rumex* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 11-v-44, pupated 15-v-44 and a male emerged 29-v-44.

GRYPOCERA.

CELAENORRHINAE.

Celaenorrhinus plagifera DeN.

Head very dark purple brown, very large and square, the upper edge slightly indented in the centre. Body dark brownish olive with a black median line. The secondary segmental divisions with lines of very minute yellow dots. Spiracles very pale pink. Venter, legs, prolegs and anal flap pale olive. 1st somite constricted to form a neck. Lives in a silk-lined leaf cell.

Pupa in a silk-lined leaf cell, attached by the cremaster only. Very moth-like in shape, the head with a minute forward-projecting central point. Colour buff, abdomen and thorax minutely speckled with dark brown, intersegmental areas unspeckled.

Food-plant—*Impatiens* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 13-v-44, pupated 25-v-44 and a male emerged 9-vi-44.

HETEROPTERINAE.

Aeromachus stigmata Moore.

Head yellow green. Body blue green, a darker dorsal line, a white subdorsal stripe and a very fine white sublateral line edged above with olive green. Venter, legs and prolegs pale green. Spiracles white.

Pupa supported by a girdle and tail pad of white silk spun on a blade of grass folded slightly by cross threads. Colour grass green, a darker dorsal line on the abdominal somites, bordered with white, a white subdorsal and a very fine white sublateral line. Shape slender, the head produced frontally into a sharp point, thorax very slightly keeled, body and wing cases unangled.

Food-plant—Grasses.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 5-v-44, pupated 9-v-44 and a male emerged 25-v-44.

Notocrypta feisthamelii Bsd., *alysos* Moore.

Head longish, the sides straight, the upper edge slightly cleft. Black with a greenish yellow stripe on each lobe extending from just below the vertex to the sides of the jaws, the clypeus with a greenish yellow bar. Body greyish green minutely speckled with dark green. A white spiracular line. Spiracles white. Venter, legs and prolegs greyish. 1st somite constricted forming a neck. Anal flap broad and flat, and fringed with short white hairs. Lives in a silk-lined leaf cell.

Pupa in a leaf cell, well covered with a waxy powder, and supported by a girdle and tail pad of white silk. Pale watery blue-green with traces of a darker dorsal line on the abdominal somites and a white spiracular line. Shape unangled, the body long, head produced frontally into a point. Proboscis sheath very long and reaching to beyond the end of the abdomen.

Food-plant—*Zinziberaceae* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 12-v-44, pupated 21-v-44 and a male emerged 5-vi-44.

PAMPHILINAE.

Baoris eltola Hew.

Pupa in a slightly folded leaf, lined with white silk, and supported by a girdle and tail pad. Colour pale watery green, a double white dorsal line on thorax and abdomen, and a subdorsal line on the abdomen only. A fine white spiracular line. Shape long, unangled, head truncate and produced centrally into a long point.

Described from a pupa found at Tukdah (5,000 ft. Darjeeling District) 22-v-44, from which a male emerged 28-v-44.

HETEROCERA.

ZYGAENIDAE.

Eterusia pulchella Koll., *pulchella.*

Jordan, *Seitz Indo-Austr. Bombyces,* ix, 32. 1908.

Head brown, retractile. 1st somite olive brown, retractile. Body olive brown tinged with golden with a black dorsal and sublateral line. 2nd to 11th somites with a subdorsal series of small tubercles, a lateral series with the tubercles on the 2nd and 3rd somites double, the tubercles of both these series olive brown, and a sublateral series of orange yellow tubercles, those on the 2nd and 3rd somites smaller. 12th somite with a transverse series of four olive brown tubercles. All the tubercles bearing one or two short colourless hairs. Venter, legs and prolegs orange pink.

Cocoon of papery white silk spun in a fold of a leaf. Pupa brownish yellow.

Food-plant—*Melastoma normale* Don., *Rubus* sp. In captivity ate *Lagerstroemia indica* L. Jordan gives Rose, Tea, Polygonum.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 10-vi-44, spun 13-vi-44 and a male emerged 5-vii-44.

Jordan's description in Seitz reads:—'Larva yellowish brown, with black longitudinal lines on the back and sides.'

ARCTIIDAE.

Diacrisia casigneta Koll.

Head black. Body black, a white lateral dot between the 3rd and 4th somites and a dotted white lateral line from the 5th somite backwards. Clothed with tufts of long black hair, except on the 5th and 6th somites where the hairs are rufous, with a few longer white hairs intermixed on the anterior and posterior somites. Spiracles white. Legs honey colour. Venter and prolegs black, the latter with honey coloured feet.

Cocoon of dark brown silk mixed with larval hair. Pupa bright reddish chestnut. Cremaster two bunches of brown spines.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 28-v-44, spun 3-vi-44 and a male emerged 21-vi-44.

LYMANTRIIDAE.

Dasychira grotei Moore.

Btlr., *Ill. Het.*, vii, 124, pl. cxxxviii, fig. 7. 1889.
Gardner, *Indian Forest Records,* iii, 197. 1938.

Head bright yellow. Body yellow, slightly tinged with greyish, with a large velvety black patch, almost circular when fully exposed, between the 4th and 5th somites dorsally. 1st somite with a subdorsal tubercle tufted with long canary yellow hair. A subdorsal, lateral and sublateral series of yellow warts on somites 2 to 11, 2nd to 3rd and 8th to 11th somites with paired dorsal warts in addition. 12th somite with a transverse series of four warts with a fringe of long yellow hair. 4th to 7th somites each with a triangular dorsal brush of yellow hair, 11th somite with a long dorsal pencil of canary yellow hair. Venter yellow with a blackish lateral stripe. Legs pinkish banded with yellow. Prolegs yellow, the feet purple. Dorsal glands greyish. Some examples have the undertint more greenish than greyish. Others have a greyish dorsal and subdorsal line on the thoracic somites and a broad grey dorsal stripe from 6th to 10th somites, and with a few black hairs mixed with the yellow ones.

Immature larvae lack the dorsal brush on the 6th and 7th somites.

Cocoon large, of loosely-woven yellow silk mixed with larval hair. Pupa dark olive brown. Head, thorax and the lateral area of the first four abdominal somites clothed with rufous hair, the rest of the abdomen, except ventrally, clothed with long silky whitish hair. 2nd to 4th abdominal somites each with a large, raised, yellow-brown, dorsal scar. Spiracles with a noticeable pale brown ring.

Food-plant—*Rubus* sp., *Quercus* sp., Apple, *Acacia dealbata*. Butler gives rose and willow, and Gardner *Shorea robusta*, *Lagerstroemia flos-reginae*, *Tectona grandis* and *Psidium guava*. It is presumably a fairly general tree and shrub feeder.

Described from a full grown larva found at Tukdah (5,000 ft. Darjeeling District) 25-v-44, spun 2-vi-44 and a female emerged 16-vi-44.

Euproctis inconcisa Wlk.

Head very dark olive brown, almost black. Body black, the intersegmental areas frosted with white. 1st somite with a white dorsal line, and a lateral line composed of white dots on the 7th to 10th somites. 3rd to 7th somites thickly clothed on the dorsum with erect, grey, fluffy hair. 4th somite with a velvety black, double, dorsal hump. 8th to 11th somites with subdorsal tufts of dark brown urticating spicules. 1st somite with a subdorsal black tubercle bearing a few dark hairs. A lateral series of brown warts bearing golden brown tufts of short hair. Dorsal glands purple. Venter black streaked transversely with grey. Legs brown. Prolegs black.

Pupa in a cocoon of brown silk mixed with larval hair. Pale yellow brown with traces of a blackish dorsal and subdorsal line. A few colourless hairs. Spiracles black.

Food-plant—*Melastoma normale* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 16-v-44, spun 19-v-44 and a female emerged 4-vi-44.

Euproctis divisa Wlk.

Head brown, shining. Body black, the thoracic somites with subdorsal red streaks and with an interrupted pinkish subdorsal line on the 6th to 11th somite. 1st somite with a subdorsal tubercle bearing a long pencil of white-tipped black hair and a brown double dorsal wart with a few short brown hairs. 2nd and 3rd somites with a small subdorsal, a small lateral and a larger sublateral brown wart with a few short brown hairs. 4th somite with a large double dorsal, a lateral and a sublateral brown wart with short brown hairs. 5th to 7th somites each with a subdorsal, lateral and sublateral brown wart with brown hairs. 8th to 11th somites with similar warts but greyish brown in colour. 12th somite with a transverse series of four brown warts. Dorsal glands red. Venter black with a lateral stripe of pinkish streaks. Legs and prolegs pinkish.

Pupa in a cocoon of brown silk mixed with larval hair. Olive brown, the head, thorax and wing cases olive. Spiracles black. Clothed sparsely with short rufous pubescence.

Food-plant—Rose, Apple, *Engelhardtia acerifolia* Bl.

Described from a full grown larva found at Tukdah (5,000 ft. Darjeeling District) 24-v-44, spun 2-vi-44 and a female emerged 16-vi-44.

Euproctis digramma Guer.

Head black. Body black, a white dorsal line on the 1st somite becoming subdorsal thereafter, and a white sublateral line. 1st somite with a subdorsal tubercle bearing a few greyish hairs and a dorsal fringe. 2nd and 3rd somites with a double dorsal, a subdorsal, a lateral and a sublateral wart with a few greyish hairs. 4th and 5th somites with a double dorsal hump clothed with dark brown pubescence, and a lateral and sublateral wart with a few grey hairs. 6th and 7th somites similar but the dorsal humps not so prominent and clothed with longer brownish hair. 8th to 11th somites with paired dorsal and lateral patches of urticating black spicules ringed with rust-colour, and with sublateral warts bearing greyish hair. 12th somite with four transverse warts with grey hair. Dorsal glands white. Venter, legs and prolegs black.

Cocoon of brown silk mixed with larval hair. Pupa pale yellow brown, the dorsum rather darker, with the thorax, wing and antenna cases very dark olive. The intersegmental areas blackish. Clothed sparsely with longish, colourless hairs.

Food-plant—*Melastoma normale* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 26-v-44, spun 30-v-44 and a male emerged 18-vi-44.

Euproctis flavinata Wlk.

Head orange. Body black, a rust-red dorsal, subdorsal and lateral stripe, the intersegmental areas transversely streaked with rusty red. 1st somite with a subdorsal tubercle with a few black hairs. 2nd and 3rd somites with paired dorsal warts with a few white hairs. 4th to 6th somites with dorsal brushes of short grey hair. 7th to 10th somites with a double dorsal and a subdorsal brown wart clothed with very short dark brown hair. 11th somite similar but the dorsal warts larger and closer together. 12th somite with a transverse series of four warts bearing short dark brown hair. A lateral series of red warts bearing a few white hairs. Dorsal glands brown. Venter black transversely streaked with yellowish. Legs and prolegs black.

Cocoon of brown silk mixed with larval hair. Pupa orange brown, the venter paler. Wing cases pale olive. Spiracles black. Except for the wing cases clothed with fine colourless hair.

Food-plant—*Melastoma normale* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 27-v-44, spun 28-v-44 and a female emerged 16-vi-44.

LASIOCAMPIDAE.

Paralebeda plagifera Wlk.

Head pale brown, minutely streaked with darker. Body pale brown minutely streaked and speckled with darker, the thoracic somites with traces of a paler dorsal and subdorsal stripe, the abdominal each with a shield-shaped dorsal mark filled in with red brown streaks and minute blue spots. 2nd and 3rd somites each with a transverse black dorsal fold filled with purple brown bristles. 11th somite darker dorsally, humped, the hump clothed with erect black bristles. Each somite with a large sublateral tubercle bearing a fan-shaped tuft composed of long, pale brown, simple hairs interspersed with a few shorter spatulate hairs, the tubercles on the thoracic somites, of which the first is double, with a dark blue spot on the anterior face. A few short black bristles dorsally. Anal claspers clothed with longish black hair. Venter black, the lateral area pinkish minutely streaked with black. Legs pinkish banded with white. Prolegs purple-brown with a double pale line. The younger larvae are more brightly coloured.

Pupa in a cocoon of yellowish silk, spun among leaves and studded with larval hairs point outwards. Colour dark mahogany, abdomen, head and thorax clothed with short, pale brown pubescence. The intersegmental areas paler in colour and naked. Apex of abdomen blunt.

Food-plant—*Maesa chisia* Don.

Described from a full grown larva found at Tukdah (5,000 ft. Darjeeling District) 4-v-44, spun 9-v-44 and a male emerged 31-v-44.

Arguda bheroba Moore.

Head blue-black with a white inverted Y-shaped mark, hairy. 1st somite black with a double dorsal, a subdorsal and a lateral longitudinal orange streak. A thin lateral pencil of long white hair. 2nd and 3rd somites with the dorsum clothed with short rufous, silky hair, a thin erect subdorsal pencil of white hair on each somite, and the skin between dorsally bright orange pink, the lateral area blackish with a white lateral and orange sublateral line. 4th somite backwards with the dorsum slate-grey and the lateral area blackish, a dull black dorsal stripe and subdorsal line composed of reddish and white streaks, the area between the dorsal stripe and subdorsal line minutely streaked with white. An orange sublateral line, the lateral area with an erect white streak on each of the abdominal somites. The posterior portion of the 7th and anterior of the 8th somite with a blackish dorsal patch edged behind with pink subdorsally. 11th somite with an orange brown dorsal hump clothed with fine black hair and with a thin pencil of long white hair arising subdorsally. 4th to 10th somites each with a few white subdorsal hairs. 12th somite with a transverse orange dorsal band. Venter black, minutely streaked with whitish, and with a white lateral stripe. Legs brown. Prolegs blackish brown with a double pale line externally. Anal flap and claspers coal black.

Cocoon of whitish silk impregnated with a yellowish powder and with the larval hairs protruding. Pupa olive brown, the wing cases, head and thorax almost black. Thorax slightly pubescent. Spiracles raised. A deep subdorsal pit between the thorax and abdomen. The apex of the abdomen blunt.

Food-plant—*Rubus* sp., *Melastoma* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 6-v-44, spun 30-v-44 and a female emerged 20-vi-44.

Trabala vishnu Lef.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xli, 314. 1939.
Gardner, *Indian Forest Records,* vi, 305. 1941.

Larvae collected at Tukdah (5,000 ft. Darjeeling District) in May 1944 were much darker than Calcutta larvae with a distinct smoky tint.

The cocoons were of dark coffee-brown silk instead of the yellow silk of Calcutta cocoons.

Cosmotriche pyriformis Moore.

Hamps., *Fauna Brit. Ind.,* Moths, i, 427. 1892.

Ovum keg shaped, the ends rounded. Very pale blue grey, a darker spot surrounded by a white ring on either side. Micropyle a dark speck. Laid in twos and threes on blades of grass.

Head pale brown striped longitudinally with darker, clothed with longish hair. Ground colour of body dark slate blue, a dark brown dorsal line edged with paler, a pale brown subdorsal stripe speckled with darker brown and a lateral series of oblique pale brown stripes speckled with darker brown. 1st somite with two subdorsal tufts of pale brown hair directed forwards and two pencils of longer hair arising from a lateral and a sublateral tubercle. 2nd somite with a dorsal tuft of black hair posteriorly and 3rd with an orange brown dorsal tuft anteriorly. 11th somite with a dorsal pencil of black hair. 4th to 10th somites with very short subdorsal tufts of black hair. A sublateral fringe of tufts of short, buff, woolly hair, the 5th somite with the tufts longer and white, the base of the prolegs clothed with longer pale brown hair. Spiracles whitish Venter black with a lateral stripe of yellowish freckles. Legs pinkish. Prolegs brown with a paler median stripe.

Pupa in a long spindle-shaped cocoon of brownish yellow silk, spun along a grass stem, and with the larval hairs protruding. Pupa dark mahogany, the intersegmental areas paler, smooth. Anal end rounded.

Food-plant—Grasses.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 1-v-44, spun, 3-v-44 and a male emerged 23-v-44.

Hampson's description reads as follows:—'Dorsum black; lateral area brown; a scarlet lateral line and strigae, grey and black subdorsal tufts on 2nd-11th somites; dorsal red-brown tufts on 1st somite and lateral tufts on each somite.'

BOMBYCIDAE.

Mustilia falcipennis Wlk.

Head dark brown with short, sparse, colourless pubescence. Body dark brown minutely speckled with yellow dots each of which gives rise to a short colourless bristle. The 1st to 5th somites darker than the rest of the body and with a dark dorsal stripe extending from 6th to 8th somite, this stripe the full width of the dorsum on the anterior edge of the 6th somite but narrowing considerably to the posterior edge, on the 7th somite of equal width throughout and then tapering to a point in the centre of the 8th somite. Thoracic somites with a blackish dorsal line. An extensile sublateral flap of skin on the 3rd, 4th and anterior part of the 5th somite, below which on the forepart of the 3rd somite is a small, black-ringed, orange, inflatable organ. 10th somite slightly humped dorsally. 11th somite with a long, down-turned, fleshy horn. Venter rather paler brown with a median black line as far as the 6th somite. Legs and prolegs dark brown. When the larva is disturbed, the head and first two somites are retracted, the flap of skin on the 3rd and 4th somites is extended, the organ on the 3rd somite is everted looking like a protuberant eye, and the tail is lashed from side to side.

Cocoon of tough brown silk, small, and spun among leaves. Pupa purple-brown, the wing cases and intersegmental area slightly paler. 4th to 7th abdominal somites each with a transverse blackish stripe from just above the spiracle to the ventral area. Cuticle punctate. Thorax with a slight dorsal ridge. Cremaster a spreading bunch of short hooked spines.

Food-plant—*Symplocos* sp.

Described from a full grown larva found at Tukdah (5,000 ft. Darjeeling District) 21-v-44, spun 4-vi-44 and a male emerged 2-vii-44.

Andraca bipunctata Wlk.

(N.B.—The larva described under this name in Part 3 of this paper, 1939, *Journ. Bomb. Nat. Hist. Soc.*, xli, 76, belongs to the Bombycid species *Prismosticta fenestrata* Btlr.)

Head dull black, small and slightly hairy. Body with the thoracic somites tapered. Pubescent. Ground colour black, marked with brownish intersegmentally. A double dorsal, a subdorsal, lateral and sublateral white line, the dorsal lines joined on the 1st and 2nd somites and the joined portion orange brown in colour. A sublateral orange brown blotch on each somite anteriorly. Venter black with a white median and yellowish lateral line. Legs yellowish. Prolegs black with an external white line. The larva is much more like a Notodontid than a Bombycid.

The larvae are gregarious and suffer severely from the attacks of parasites. The resting attitude is contorted, the larva gripping the support with the last three pairs of prolegs only, and holding the anterior and posterior portions of the body erect, the head and first two somites usually curved right back.

Pupa in a thin cocoon of brown silk spun among leaves. Colour dark purple brown, the wing cases slightly paler. Cuticle minutely wrinkled and punctate. Last somite blunt and clothed with short golden brown pubescence.

Food-plant—*Symplocos* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 3-v-44, pupated 8-v-44 and a female emerged 3-vi-44.

(*To be continued.*)

SOME REMINISCENCES OF SPORT IN ASSAM.

BY

H. G. H. M.

(*Continued from page* 118 *of this Volume.*)

Part V.

Rewak, in the centre of the Hills, is a delightful spot. The first time I went there two rogue elephants had been proscribed; one was a tusker the other a makna. We tracked them into very heavy, dense jungle where it would have been folly to attack them, especially as the evening was closing in apace. I gave up the idea, and having unloaded my rifle handed it to a Garo who took it up to the village where the people were drinking rice beer. My servants got in with this crowd and I and a Turwa orderly walked on. We were nearing a very large tree when the orderly said, 'I can see the rogue elephant!' and immediately bolted. Going up to the tree I searched with my eyes in every direction but could not make out the animal when, as I was peering round the trunk, a heavy blow struck me on the shoulder. I thought this was from the trunk of the elephant and got a terrific shock! It was the head Garo of the village who had felt uneasy about me and followed after. 'Come', he said, 'come at once, for one of the rogues is above us and the other below.' He took me back to the village by a path and then said, 'It is too late and too dangerous to attempt to return to the bungalow to-night, so you must sleep at the village.' I lit a pipe and let them drink on, and then told them that I must return as my wife would be very alarmed if I did not do so. After some more potations they were persuaded to accompany me and procured a number of blazing torches. We were passing a clearing a little further on than the aforesaid large tree when there was a shout of, 'Here comes the rogue' and they quickly formed a ring and set fire to the jungle, holding their torches on high. One elephant came right up to the edge of the jungle and was clearly seen. It was the tusker, and I should have fired at it, for had the shot not killed it it would have frightened it away. However, it remained close by. There were now many Garos and they formed a double ring round me. The outer ring went on their knees, holding their spears at an angle, and the inner ring stood with spears held high. They advanced in this formation, burning jungle going ahead, until we reached some boats on the river bank. Into these we all got, torches still burning, and soon gained the centre of the river from where we saw the two elephants following us along the bank. Fortunately they did not cross the river, so we landed on the other side and went up hill to the bungalow as fast as it could be done. The Garos stayed all night near the bungalow and by morning the elephants had gone; there was no trace of them. So ended a very exciting experience.

Six Tigers in one Hour.

Mention has been made of six tigers killed in one hour, and it will be conceded that was good hunting. It was when G's camp was not far from the Grass Reserve at the foot of the Bhutan Hills. Some tigers had already been bagged, but on that memorable day it was decided to try for buffalo. The difficulty was to get a shot at the desired animal, which had been seen to have outstanding horns, before it could escape into the sanctuary of the Grass Reserve. After we had failed to get a shot, the Rajah said he would take some beating elephants and try to drive the animal towards us, and placed us so that we could command a clearing in the jungle. 'Now that you four sportsmen command this clearing you may perhaps secure this buffalo having an exceptional head' said G as he moved off towards the edge of the Grass Reserve. We four, the two Ms, the Raj Kumar and I were so placed that we could see any animal coming into the clearing without it seeing us, high up as we were on our elephants and looking over the tall grass. Suddenly a tiger ran across the clearing, taking us all by surprise so that not one of us fired. No buffaloes had been moving and we were not watching the clearing as we should have been. When G came up he scolded us, 'You are a nice lot of shikaris; muddled the buffalo shoot, and now the four of you allowed a tiger to go past without firing at it. Disgraceful.' 'Now', said the Kumar Saheb, 'we must go and get the tiger or father will be very angry indeed.' So off we went with beating elephants, ringed the tiger as they do in Nepal, and drove it towards G. It was a big tigress and he killed it. We then apologized to him for our disgraceful behaviour as shikaris, and got him to again take an interest in the shoot. He went on ahead and we four were talking, our elephants close to one another, when we saw three tame buffaloes pass into some jungle. This patch of heavy jungle was narrow and the buffaloes had only just gone into it when one of them was killed by a tiger. This was in broad daylight, midday, and some villagers on their house tops called out to tell us of the kill having been made. In such manner do the inhabitants of some parts of Assam live close to savage wild life.

Some beating elephants were at once put in. Where I was stationed the Rajah was just behind me. Suddenly someone called out that the tiger was in the open, behind other guns who were advancing. Two of them swung round and fired, and the tiger dropped dead. Both were using 12 gauge Paradox guns, and that evening had to toss for the claim. It was M who won the trophy. This was a heavy 10 ft. tiger. G always emphasized this point, 'Never be certain what a tiger will do.'

The tiger having been padded we pushed on to where there were said to be four more tigers. The beating elephants went into position, the Raj Kumar with them. I was placed by G where I would be certain to get a shot, and warned by him that I would be charged. Soon the beating elephants signed there were four tigers in the beat. Three came along into the light jungle and were seen by the guns on the right but not fired at. They wanted to see the fun when I would be spotted by the tigers. They had their 'tamasha', for two of the animals charged me. I turned the leading one head over heels with a bullet from my .475 rifle, but the other one pulled up and rejoined the third animal. One of these was killed by G, and the other by M. The Raj Kumar shot the fourth as it was trying to get out of the beat. The Rajah was now very pleased with the bag—six tigers within one short hour, and said we were all very fine shikaris. On arrival at camp we chaired G and carried him round to the accompaniment of 'He's a Jolly Good Fellow'. That red-letter day was the Rajah's birthday anniversary, and no more suitable present could have been given to him than six tigers all shot in a space of one hour.

TIGRESS AND CUBS.

One day when roaming about in the jungles I came across two tiger cubs, and as soon as the elephants got close to them they began to growl. They were in some cane jungle near a village. In Assam a tigress frequently has her cubs near a human habitation, and you will find female tigers near to a village even though there are no cubs. It is well known that the male tiger may kill, and even eat, the cubs on occasion, and that perhaps is why the tigress has her cubs near a village and keeps them there. We passed along, and shortly a mahout signalled there was a 'hullee' in front of me; this kept moving in a circle. It was the mother trying to guide the elephants away from where the cubs were. There was a sea of grass and she could have gone right away; but although she kept on giving the idea that was her intention, she would before long circle round in the direction of the cane brake. The elephants were trampling the jungle down, as they circled around following the tigress's movements, and I knew that she would eventually appear in one of the lanes so made. Suddenly she presented me a view of her broad back just to the right of my elephant, a mark I could not have missed, but unfortunately, though the striker indented the cap, the cartridge did not go off. Opening the rifle I extracted the cartridge, thinking the fault lay with it, put it in my pocket without examining it, and placed another in the breech. After a time I again saw the tigress's back, again presented the 280 rifle and pulled the trigger with the same result as before. I now realized the striker must be at fault, and when I eventually got another chance and fired the left barrel there was a rush away and I was sure she was killed. Darkness was fast approaching so I thought it best to make for camp. In the morning the tigress was recovered and the cubs were caught.

SHOOT AT KOCHUGAON.

In April 1924 Mr. H.P.S., who was Forest Officer at Goalpara, invited my wife and me to a tiger shoot at Kochugaon. Several things happened at that shoot which are interesting.

I was asked to bring along solid bullet ammunition as the Assam Government had ordered a male elephant named Urthumpersad to be destroyed. He was a fine tusker but an unreliable animal, and had killed many attendants, mahouts as well as grass-cutters. I knew him well, and as a shikar elephant he was dangerous so could not be used for howdah work. I remembered that he had screeched and bolted when men were trying to put a shot jungle fowl on his back. He was a timid and a terrible coward. On our way we picked up the Rajah of G who had been also asked to the shoot and to assist by taking charge of the arrangements and giving use of his elephants to supplement the animals of the Forest Department.

While we were at tea at Kochugaon G, who did not drink tea, sat quietly listening and then declared, 'It would be a shame to shoot the animal, for perhaps with care he could be trained to become useful, as a beater if nothing else. The mahout is probably to blame.' C, who had just arrived from England and taken charge of the District as Forest Officer from S remarked to G, 'You could never train that animal, nearly all the forest officers in the Province have at some time had the elephant in their charge and it has invariably been the opinion that he should be destroyed.' G said, 'I would like to try and reform him, for mahouts are often to blame—they are themselves frightened and make the elephant useless. If you will sell him to me I will give you the price of his tusks.' C agreed, and Urthumpersad was taken to G's elephant lines. Two years afterwards I saw the elephant at a shoot and used for howdah work. He was perfectly steady even when he knew there was a tiger in front of him, and tigers were shot from his back. What G could not drive out of him was his uncertain temper, for I know he killed grass-cutters while with him, and he eventually had to shoot him as hopeless in that respect, the culminating incident being that he was loaned to the Forest Department, along with other animals, and while there, as seen by B, another forest officer, seized an attendant with his trunk, carried the unfortunate man across a stream and killed him.

One day we went to a far away grass jungle and beat a large piece of it with all the elephants in line. In places the grass was so high that even howdah elephants on either side could not be seen. I was on the extreme right on Mylo, an elephant which later on proved to be one of G's best howdah animals. On this occasion he killed a small hog deer with his trunk as the animal ran across him. Mylo is a small 'mukna' and I have many times seen him stand the charge of a tiger. Suddenly the Rajah beckoned to me to come to him, and in a fairly large clearing I saw a small beating elephant being chased round and round by a female rhinoceros with its half grown young one following after. It was a fine and unusual sight. After chasing around some of the other elephants she went off with her young one. This affair had caused a great dispersal of the beating elephants and most of the Forest Department animals were missing, including the mounts of C and S which completely disappeared. G said that it was because the Forest mahouts feared the rhino and so got their animals out of the arena as quickly as possible.

On a Saturday morning a kill was reported a long way off so an early start was made. On arrival at the ground G inspected the kill and turning to me said, 'Now, Sir, where is the tiger?' Thanks to his tuition I was at that time fairly learned in the habit of tigers, so I pointed to the 'nakul' jungle. Nakul is a broad leafed plant growing very thickly and in it a tiger finds plenty of shade during the hot hours of the day. 'Yes, and you are to drive him out and not shoot unless he attacks you.' He then proceeded to arrange the beat and place the guns. C was placed on the ground below and when the beat commenced I pushed on to a thick part of the nakul jungle. When I arrived the tiger showed his very plain displeasure and growled continually, but never showed himself. Mylo, perhaps wisely, refused to walk on top of the tiger although urged by the mahout. I was in a difficult position for had the tiger attacked I could not have stopped him. Had he made a move to do so I would have fired off both barrels to try and save the elephant from a mauling, for if hit or not the noise can have the effect of halting a charge. Some beating elephants came up, and shouting together the mahouts forced the tiger on, and he broke cover towards C. Soon I heard a shot and then saw C's elephant bolting out of the fray. G came up and asked why C had not shot the tiger, and where is he? 'There' said the mahouts, 'there he goes. *Wo jata hai....Wo gaia!*' and his elephant was not stopped for a long distance. C later explained that he was helpless as his elephant danced a polka as soon as she discovered the tiger coming.

Next day, Sunday, early report arrived that the tiger was back in the same place. It being Sunday I said I would not go out and of course was ragged, and told I had a slave mentality and so on. However, the others went off after breakfast. G located the tiger and arranged the beat, again putting C in the best position. He told C that the tiger would come along on the top of the nala bank and not along the nala bed, but C, being of opinion that a tiger always comes along that way considered that he knew better than G so took up position in the bed of the nala. The tiger, of course, came along the top as predicted by G and C was too late to get his elephant up the rise to meet him; worse, he disturbed a nest of hornets which attacked the elephant and its riders. The elephant, maddened with stings, ran all over the country and did not get to camp until after dark. C had two stings high up on the neck near the spine and could scarcely stand. I assisted him to a chair, gave him a stiff peg of whisky, and went off to the dispensary to obtain medicines and a hypodermic syringe. Mrs. C, not knowing I had given him a stiff peg gave him another and put him to bed. He was soon asleep! During the maddened elephant's rampagings in the jungle C lost his spectacles, camera, thermos flask, none of which were ever recovered. After this experience he said he would not again joke about Sunday shooting, and would not shoot on Sundays. This is another instance of how tiger shooting off elephants can be dangerous.

Bees and hornets may be disturbed during a beat, or at any time, even when going to or returning from the jungle, so one must not forget always to have a blanket with one when on an elephant. The placing of the blanket over the elephant's eyes may also have the effect of stopping the running away of a 'musth' elephant.

On Monday morning news was received of a number of tigers giving trouble a long way off. When we got to the place, we, S and I, C had not come out as he felt helpless without his glasses, thought the place looked very unlikely and we were disappointed. G was cheerful and said he had bagged tigers in more unlikely places. There was a small stream and the grass jungle about it was not extensive, neither was it dense, moreover there were fields all round and people working in them all day.

G placed himself on the bank of the stream with S on the other side and I on his right. The beat had barely advanced 300 yards when it was signalled there were three tigers, and G passed word to us to be prepared for a charge as we were barring the way to the thick jungles the animals had come from. Soon the Rajah told us to move towards the beating elephants. A tiger charged G, and staunch as was Rung-Bahadur he jinked, so causing G to miss it in the air as he came; the explosion baulked the tiger so he failed to get on the elephant. Again G was charged by the same or another animal, but this time he killed it in the air and I saw it fall in a heap. We had scarcely advanced a hundred yards when I was charged by a tiger which came at me over an open field. I had a fine view of it, and when I fired it sat up like a great cat and sort of stretched itself. I fired again and it jumped sideways into some cover. When we looked we found it dead. G now stopped the beat until S could get across the stream to our side and have his chance. Presently we saw S put his rifle to his shoulder and two tigers sprang across the opening he was guarding. He wounded one which went across the stream. It lay down in full view and he fired shot after shot at it with his 500 black powder rifle. We could see the bullets hit and cause wounds, but these were only surface wounds. We crossed the stream and finished it.

We thought the fourth tiger had gone right away and S and I had got down from our howdahs, G also, when a mahout reported he had seen the tiger not far away. G hastily mounted, and before the tiger could reach the dense cover he shot it. It was barely an hour since we commenced to beat this unpromising place and we had killed four tigers! Two were males and two females. Back at camp C cursed his luck and was fully convinced of the wrongness of Sunday shikar.

The cartridges of the .500 black powder rifle S was using were loaded with the light .340 grain bullet having a long hollow and small base; the .440 grain heavy based bullet is the proper one to use with that rifle.

Next morning a tiger was reported within half a mile of the camp and G sent word asking us to turn out. C could not go without glasses and S was too tired. I went with G and got on to Mylo, and we took our positions. I knew G had directed the tiger should be driven to me but made up my mind to let it pass on to him. It came from in front of the beating line into some scrub jungle and was passing along towards G when a beating elephant came out and turned it back; I could not see where it was when it suddenly stood up on its hind legs before Mylo. As it went down again I threw up my rifle (.280) without taking aim and by a mere fluke hit it in the side of the head. The skull was broken into several pieces and the animal was instantly killed. The distance was close, about 15 yards. The mahouts saw the tiger go over and cheered; and an Indian Forest Ranger remarked, 'That is the man to go out with for he can kill a fighting tiger with one shot.' I told the Rajah that the tiger was not fighting and was killed by mere chance. He put his finger to his lips, 'Hush', he said, 'you must never own to a fluke to the mahouts. You have greatly enhanced your reputation with them so any of them will be prepared to keep his elephant still, depending entirely on your shooting. A person who has missed several times, though he be a first class shot, will not be trusted by the mahouts and he can talk and tell them what he likes, they will pretend to agree, but will hold to their own opinion saying among themselves that the man who has fired three shots and not hit once can't be any good; and whenever possible they will make the elephant bolt before the tiger gets near, or will make some excuse to get the elephant out of the way and into some position where no tiger is likely to come. They well know the habits of a tiger and will be able to arrange that you do not get a shot.

How a Tiger Charges.

Viewed from an elephant a tiger's charge is nothing like what it is popularly thought to be, a roaring and coming at you with leaps and bounds. It is absolutely silent except for the first warning grunt as it breaks cover, and it comes along very fast with its belly almost touching the ground, no bounds. When within springing distance, about 15 to 20 feet from the elephant, it springs to land on his trunk. I have seen the charge time, and time again, it is always the same. What the charge against the man on foot is like I do not know for I have not seen such a performance, but I think it must be similar.

A tiger's back as viewed from an elephant is fairly broad, and if the bead is placed in front of the on-coming beast, and moved towards it, and the trigger pulled as soon as the bead touches the centre of what is really the head, the bullet will probably get the chest through the back. A charging tiger, seen from an elephant's back, may be described as having the shape of a gigantic tadpole.

Wildfowl and Wild People in Manipur.

Manipur is famous for its duck shooting. The jheel is seven miles long and affords fine sport. The shooting is conducted quite differently to shoots on jheels in other parts of India. In Manipur platforms of wood and bamboo are erected in various parts of the expanse of water, and in the grass. They are quite hidden as they are maintained all the year round, and the grass grows all round them thus entirely hiding them, and as the birds have been all about and around these machans in the water without being scared, when a shoot is in actual progress easy shots are obtained, at any rate, at first. When the sportsmen have taken up their positions a number of boats, with a gun in each, go around the jheel putting up the birds and then the fun begins. Round each platform is usually some clear water so that birds shot can be easily retrieved. After a time boats come round and pick up the dead birds. While this is being done the birds settle down again, and after they have rested a while the whole proceeding is re-enacted.

Enormous bags have been made in this way. I think Colonel G. of an Assam Battalion stationed at Imphal held the record of 300 to his own gun; and he once shot 90 geese in one day. On the last time I did a shoot at Manipur I was stationed at Kohima and we used often to go into Imphal to play cricket, about which the then Maharajah was very keen. On those occasions we would also put in a day or two of duck shooting. Very large bags of snipe have also been made there, Colonel G. again holding the record in those parts for a single gun.

When great celebrities, Viceroy, Governor, and other High Officials visited Kohima there would be extensive security arrangements. The Naga hillmen used to undertake to guard the road from Dimapur to Kohima, and again from Kohima to the boundary of the Naga Hills. They lined both sides of the road and were dressed in full war regalia. They of course searched in the jungle on both sides of the road and any evilly disposed man would have received the shortest of shrifts, for his head would have been instantly lopped off in skilled headhunter fashion! From the Naga Boundary to Imphbal in Manipur the roads were lined on both sides by armed men of the Assam Rifles.

Naga dances arranged in honour of these official visitors were very special entertainments for eight tribes dressed in their colourful tribal costumes danced their very best. It is a very gorgeous, spectacular affair and there is a certain amount of danger, for most of those taking part are more or less drunk on their homemade rice spirit, and it would not take much provocation for one tribe to use spears or other weapons on another. At the present day (1944) the Nagas will not be as they were in earlier days for the improvement of road and the military traffic and other activities have brought many aspects of civilization to the originally simple tribes.

One evening we heard a barking deer call, on the hill above the bungalow. I asked my wife if she would like to try for it and as she said she would I told her to go up the fields by the regular path and I would go by another way which would probably cause the deer to move in her direction. As I got to the fields, which were not in use at the time, and in them were a lot of logs lying about some trees having been cut, I saw an animal which I took in the failing light to be a reddish calf, for a little higher up the hill there were cattle kept by a Garo. I thought the calf was a straggler going up to the byre, and it never entered my mind that the animal might be a tiger.

As my wife came on to these deserted fields she saw the tiger: it was only twenty-five yards from her and looking in her direction. Rakal Singh was with her and kept his head and did not do anything silly. The tiger was perhaps a little closer to me than twenty-five yards. My wife called out to me that to my left is a tiger. I knelt behind a log and covered his chest but had sufficient experience to know that if I fired and the animal was not killed outright he would spring in the direction he was looking, and that was in direction of my wife, so it would have been madness for me to fire. The tiger turned and was soon out of sight. My wife showed no panic or fright at all and looked at the tiger with no attempt to get away in the other direction. Few women have been so close to a wild tiger in its natural jungles.

PYTHON AT MOHENDRAGUNJ.

While I was staying at the Inspection Bungalow, Garos came and told me that a herd of mithun were destroying their fields and one of them had very fine horns. For various reasons the search for the animal with the big horns failed. On the largest of several small hills there was a pathway leading right round it. A Garo tracker and I were following the spoor of the mithun and the shikari went on ahead to spy round the corner. I remained behind and, not knowing it, was actually standing six or seven paces from a python lying in the grass with its head protruding from a bush. I beckoned to the shikari to come back and he was talking to me when, why I did I cannot say, but I looked to his left and above on the hill I saw the thick body of a large python lying in an upward direction along the hill. Now, following the snake's body downwards I found it ended in a bush by which the shikari was standing. Walking towards him I saw the creature's head—it was almost touching his toes (a matter of inches). I drew the man gently away and as soon as he was clear of the bush drew his attention to the snake by means of signs. He pointed to my rifle but I shook my head. He then took a large knife I was wearing and cut a thick branch, as thick as my wrist, and having trimmed it went towards the snake and, taking aim at its head very deliberately killed it. As soon as the head was hit and completely crushed the body moved about until it rolled down the hill. It was 13 feet long and was not gorged for it had nothing in its body. Was the shikari in any danger when his toes were within inches of the python's nose? Pythons watch game paths to seize deer and other animals passing along and it is strange that it did not attack the man.

ANOTHER PANTHER STORY.

My wife and I arrived at Kirapara about midday and the watchman reported that a panther had killed a cow that morning and dragged it into a near-by ravine. After having had something to eat I went with Rakal Singh, shikari, to view the 'kill', and we decided to sit up straight away. By his tracks we learnt that the panther had gone up the hill opposite to where we were concealing ourselves. He could not but return the same way he had gone. I had with me a .280 straight-pull magazine rifle, and a 12 gauge gun loaded with buckshot cartridges, the best weapon to use at close quarters against panther.

It was exactly 4 o'clock when Rakal Singh kept on kicking at me from behind. He was trying to tell me that the panther had arrived. I knew what he meant but could not see the animal, though I searched every inch of ground around the kill. I tried to slowly turn round but the beast instantly detected the movement and bolted, making such a noise that it was at once apparent where he had been—a good distance above the carcase, on the hillside. The shikari said in a very disgusted way, 'Had you only looked above the kill you would have seen the panther sitting up like a dog and looking at us. You could have easily shot him, He had been there five minutes and I hadn't seen him.' 'Now,' said Rakal Singh, 'he is hungry, and we will get him. I will fetch some Garos to drag the kill to just below the bungalow where you can sit up for him.' I said he would not follow the drag. 'Oh yes,' said the shikari, 'he will follow by scent.' When the carcase had been dragged to where wanted I had dinner, and Rakal Singh tied a lantern to a bush close by, so lighting the carcase very well. I doubted whether the panther would put in an appearance but all the Garos said, 'He is very hungry and has never been shot at, he is certain to come back.' I got into a small tree at the edge of the bungalow compound but could not see my rifle sights. My wife suggested that if he was thought not to mind a light near the kill, he would not object to one up the tree. So a man climbed up, tied a rope to a higher branch and lowered the lantern until I could see my sights.

In about half an hour I saw a grey object rising from the back of the kill, and it appeared to get taller; it was only a grey thing I could see and I could not say it was the panther. However, I fired a shot at it and it disappeared. After a time the same grey object started to again appear and I fired another round at it. Then there was a rush towards the tree on which I was perched, then a sudden turn to the right, and a rush into the jungle followed by several groans. The men said the beast was dead, but I refused to let them search in the dark. Though I had warned them not to go in the morning until I was with them, the waterman did go. He climbed several trees until he descried the dead panther. It was a forest-dwelling, game-hunting panther in good condition, and not the kind which frequents the vicinity of the villages, so had no experience of men and their ways.

One ·280 bullet had hit it in the back and run along close to the spine without injuring it; the other had also hit the back, but at a different angle, and entered into the chest severely damaging a lung. This was the shot that killed it. The first bullet had come out near the tail and then burst in the ground. The interesting part of this affair is that the panther was not put off his prospective dinner by the first explosion of the rifle and the bullet passing under his skin for the length of his body, a wound which must have felt to him like the lightning thrust of a red-hot skewer!

THE LAST SHOOT.

The latest shoot I was on my wife and daughter were of the party. It was a long journey from Bangalore to Calcutta. I had not attended those big shoots for five or six years and there were some gaps among the well remembered attendants. The old cook was dead, so also the schoolmaster and the head shikari. Among the elephants Rang Bahadur, Sibjee, and others were absent but Jang Bahadur and Mylo still working. Our old friend, the Rajah of G. was as pleased to see us as we were to see him, and we had much to talk about.

It was reported that a large tiger had killed in a certain jungle so we all set out, my daughter in my howdah. The tiger was to be shot by an Indian guest so M Senior was stationed next to him to see that matters went as intended. The tiger was found, and the beating elephants swung round to push him towards the lighter jungle when it was suddenly seen that a party of women and children had entered the grass and got ahead of the tiger. They, of course, did not know that a beat was in progress, and as it had taken a little time to diagnose this new 'hullee' it was realized they were in great danger. The beat was spoilt as the mahouts had to shout to the people to clear out of the jungle, and the result of all this was that the tiger went left instead of right. It could be seen by his 'hullee' that he was in front of me and I prepared to fire but he did not show; for after about a minute—evidently turning over in his mind what he would do, he moved towards M.

Junior who gave him a mortal wound with a heavy conical bullet from his 12 bore Paradox. The wounded beast then passed through a clear space, going slowly, and Dorothy got her first view of a wild tiger, and a big one too. I fired and he rolled over into the grass. A fine beast measuring ten feet over the curves.

I have always considered skin measurements over the curves to be the better method, as it is then possible to compare lengths of animals with those shot in the years before the peg-to-peg measurements began to be considered correct. The difference between curve and peg measurement, if each are properly taken, is some six to eight inches. The twelve feet tigers of former days were the result of wet skin measurements, skins after removal from the animals being pulled out as far as they would go thus giving the appearance of a striped python on the ground. A friend has recently told me that he himself read the original report of a sportsman who wrote, not twenty years ago, to the Civil Officer of the District that he had just shot three tigers 13 ft. 9 in., 12 ft. 7 in. and 11 ft. 10 in. in length! That was the method employed; so the foolish practice seems to still exist.

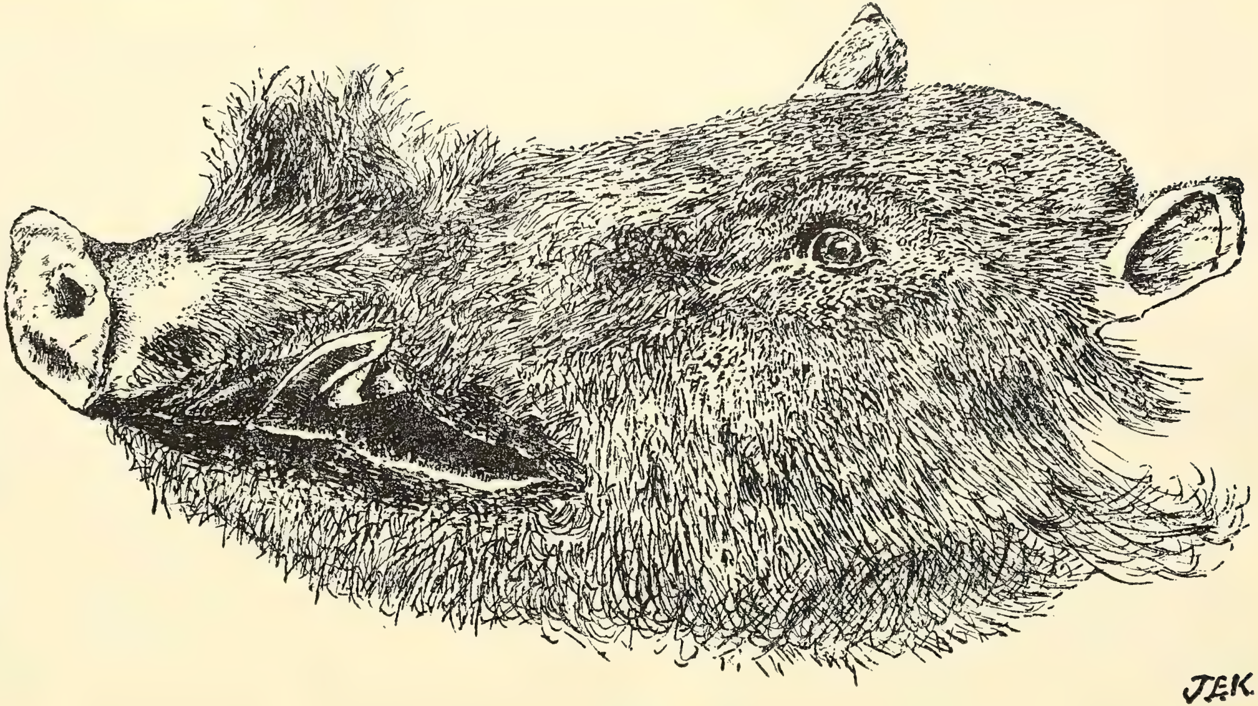
One day four tigers were obtained, one of them being shot by me with the .280. My daughter now begged to be allowed to shoot a tiger, and the Rajah said he knew this request was coming as he had received a letter from her husband saying 'she is a very good shot at a target'. 'So', said G. 'your girl may have her chance provided you take charge of her and see she makes no mistake'. To this I of course agreed and the beat next day was arranged for her benefit, but so that she could only fire in one direction, the elephants of the brothers M. being on either side of ours. G. lent D., which will stand for either Dorothy or 'Diana', his D.B. .450 black powder rifle. The tiger was pressed forward, but seeing our elephant waiting for him growled and went back into heavy cover where he demonstrated against some of the elephants causing them to scare. G. then went to the beating line and brought it along very silently.

Being over anxious that nothing untoward should happen I loaded D's rifle in the left barrel only, telling her to pull the left trigger. The tiger jumped out with a grunt, and in her excitement D. pulled the right and not the left trigger. She had a good view of the tiger, and it can be said that the loss of her opportunity was my fault as the right barrel should have been loaded. G. realized that I, her father, had too great a responsibility so, with his usual kindness and generosity, took her next day in his own howdah. Two three-quarter cubs appeared in the first beat. In a second beat one of these two beasts was brought to D's gun and killed by her, her first tiger and one of three killed that day.

* * * * * *

The author of this series read the almost completed compilation, culled from his several Note Books, before he became ill early this year (1944).

Major H. G. H. Munrowd was not, unfortunately, a member of the Bombay Natural History Society. His death took place at Bangalore on the 21st March 1944. All members will be at one



Sus barbatus BEARDED PIG.

Drawn from photographs by Mr. Romenij in 'Journal Royal Asiatic Society', Straits Branch; No. 45: 1935.

with the Committee in expressing regret to his family that he should have passed away before seeing his experiences in print and contributing, as he had hoped to do, some more of his interesting Assam Reminiscences.—Eds.

(*The end.*)

THE RIDDLE OF THE BEARDED PIG.

A PROBLEM OF DISTRIBUTION.

BY

J. E. KEMPE

(*School of Oriental and African Studies, London University*)

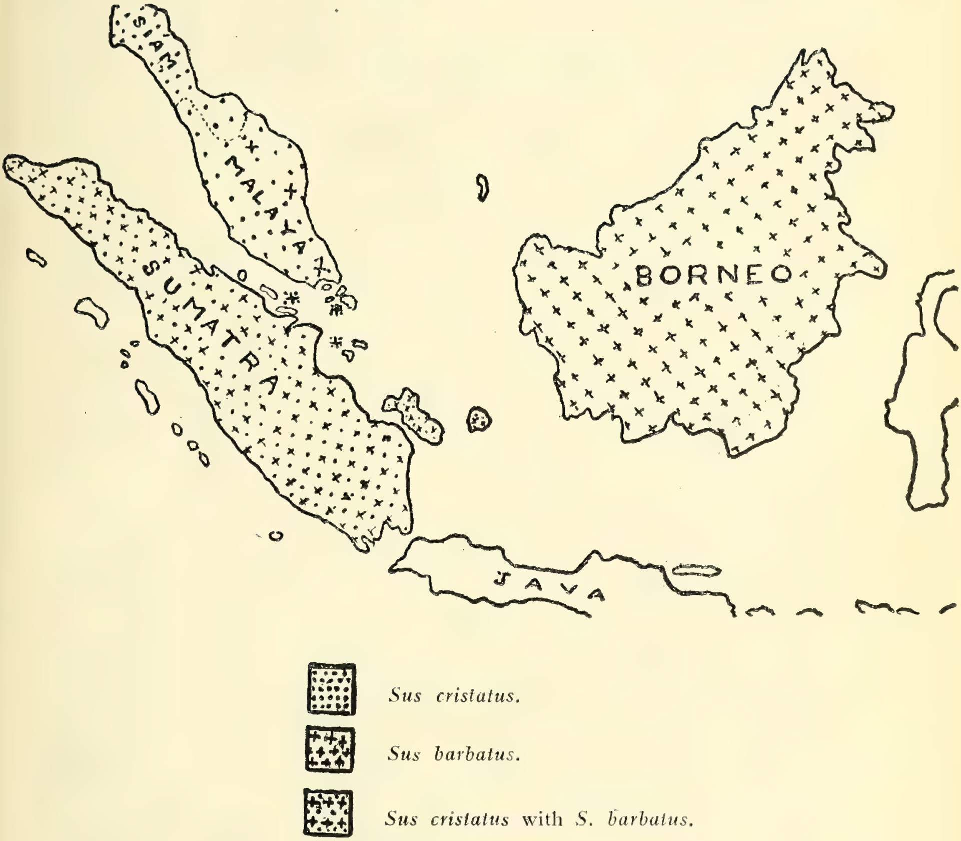
(*With 4 plates*)

Three distinct species of wild swine have for long been recognized in the western portion of the Malaysian sub-region, that is the area (excluding Celebes and the Philippines), lying south and east of Burma, together with a number of somewhat disputable local forms. These are *Sus cristatus* (local representative of *Sus scrofa* of Europe and western Asia including India and Burma), *S. barbatus* of Sumatra, Borneo and the Riau Archipelago and *S. verrucosus* of Java. The last is not of interest in this discussion and may be dismissed. *S. cristatus* and S. *barbatus* overlap and occur together e.g. in Sumatra. But that the only wild pig of the Malay Peninsula was *S. cristatus* was never in question until 1918, when Dr. W. S. Leicester of the Malayan medical service, stationed at Pekan in the State of Pahang on the east coast of the peninsula some 160 miles directly north of Singapore, shot the sow of a species new to him. Dr. Leicester kept a pack of mongrel dogs and for some years hunted that remote country as a regular pastime. He apparently shot several half grown young pigs as well about the same time, and in December of that year sent the sow's skull to the Director of Museums at Kuala Lumpur (the late Mr. H. C. Robinson). The latter, in his own words, found 'the occurrence so remarkable and so at variance with preconceived ideas of geographical distribution, that, pending further evidence, it was not considered advisable to place the occurrence on record'.

There the matter rested till September 1921 when the writer, stationed at Pekan as District Officer and quite unaware of the foregoing, was shown the skull of a pig shot by an old Chinese named Lee Chu'ah with whom he frequently hunted. Chu'ah shot the animal at Sungei Genoh a week before, a mile or two out of the town. It was an old solitary boar and much emaciated. What impressed the man was its great height and length of leg, the length of its skull, a pallid skin, the tufts of hair under its eyes and above all its whiskery beard. It weighed 244 pounds and he thought that in condition, it should have scaled well over 300—and a Chinese is no mean judge of pig-flesh. Chu'ah had hunted that coast for nearly forty years and never before saw such a monstrous pig in all the thousands killed by him. (The old man, a great comrade in a lonely place, died two months later.) I at once sent the skull which he gave me to Major Moulton, the Director of Raffles Museum, Singapore. To me it was an astonishing object, and comparative drawings of it and the common *S. cristatus* made the difference more remarkable. It was not I think a very big specimen judging from the measurements of the skull. Chu'ah who combined business with pleasure and a genuine interest in his quarry, had for years kept careful records of his kills. The heaviest recorded pig of the common type was he told me 286 pounds (he showed me a grubby notebook full of Chinese characters and ill-formed English figures, for he was by way of being a scholar), but his pack was probably unequal to stopping any thing much heavier. The tushes of the strange pig were nine inches round the curve and 4/5 inch across. The Director of Museums identified the skull at once as that of *Sus barbatus* of Sumatra and Borneo and Riau, and retained it as 'the first authentic record of this species in the Malay peninsula'. In March 1922 there appeared an article in the Journal of the Royal Asiatic Society (Straits Branch) No. 85, under the hands of Major Moulton and Mr. H. C. Robinson. The species was accepted as a member of the Peninsula fauna though they thought its presence 'is really due to some extraordinary chance resulting in the landing of a herd from Borneo, the home of the true *S. barbatus*, or from the Riau archipelago'. If, as the writers pointed out, it is a Peninsula species, the geographical position is difficult to explain, but under *very* favourable circumstances individuals might come over from the islands and establish themselves in small numbers for a noticeable period. The verdict was '*not indigenous*', that it was probably the last survivor of a herd that had gained access to Malay peninsula. The matter rested for a time but the question seemed to me, in face of the facts, to be by no means settled.

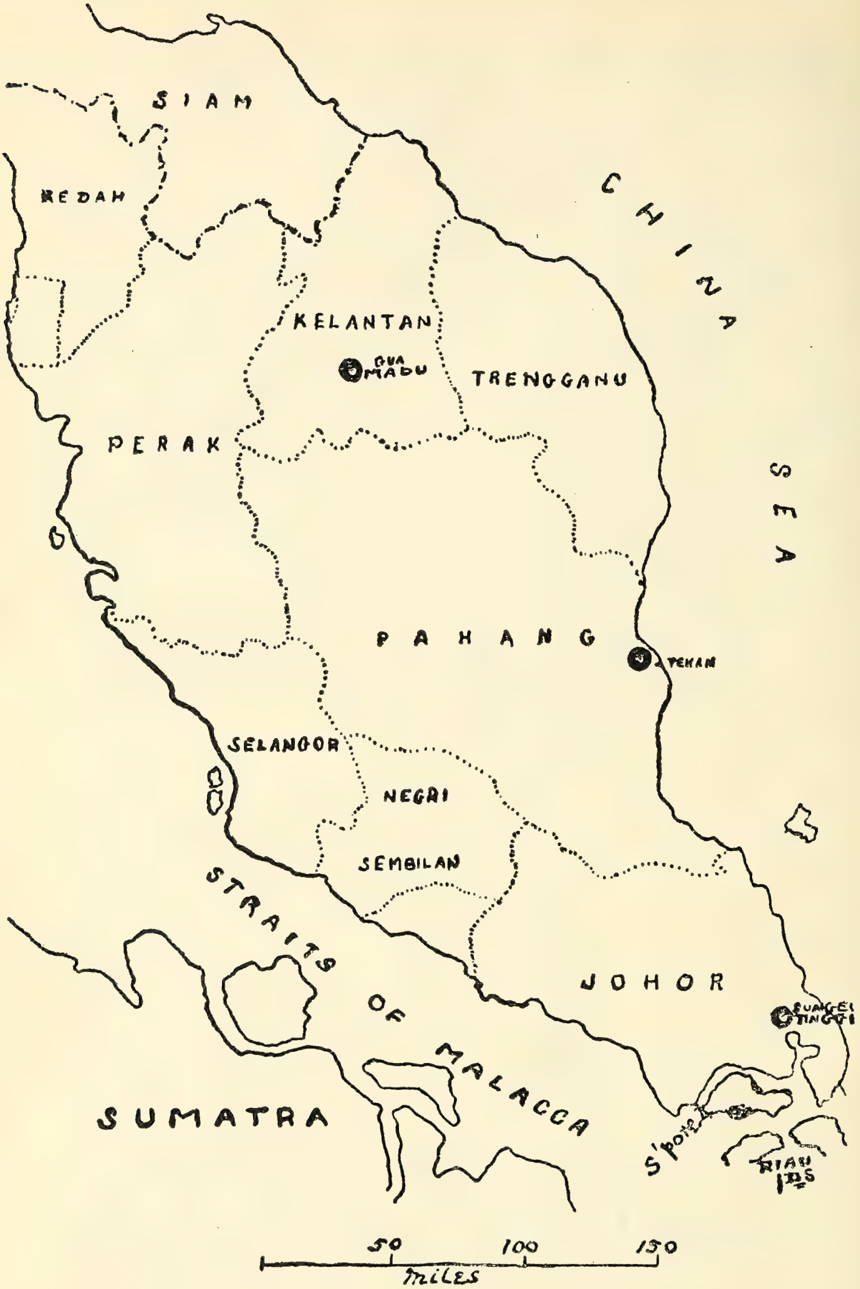
Seventeen years later, in March 1939, I wrote to the then Director of Museums in Singapore (the late Mr. F. N. Chasen) and enquired whether the Bearded Pig had turned up again since, and if so, what was the present view of the matter. In April of that year he replied that the pig had turned up on several occasions in small numbers on the east coast of the peninsula but not on the west. The latest example was a fine boar from Kota Tinggi, near the southern tip of the peninsula. This specimen was retrieved by Sir Richard Winsted from an Italian who expressed the intention of sending it to Signor Mussolini. He was easily persuaded to hand it over by the suggestion that the head of a *seladang* or any other head would please the Duce just as much, and it was placed in the Raffles Museum. The Director went on to a 'possible' (but most surprising) solution of the presence of the pig in Malaya—it was evident that the Museum authorities were uneasy about it! He stated that the Chief Minister of Johor was certain that 'our *barbatus* pigs are the remains of some introduced by the old Sultan many years ago—for sporting purposes—and may be he is right'. (This aspect is referred to at greater length later).

PLATE II.


SIAM
MALAYA
SUMATRA
BORNEO
JAVA
Sus cristatus.
Sus barbatus.
Sus cristatus with *S. barbatus.*

Map of the western part of the Malaysian Sub-Region showing the known distribution of *Sus* on the larger land areas.

The Javanese species is *S. verrucosus*. The species themselves are divided into several local sub-species.


SIAM
KEDAH
KELANTAN
GUA MADU
TRENGGANU
CHINA SEA
PERAK
PAHANG
TEKAM
SELANGOR
NEGRI SEMBILAN
JOHOR
SUNGEI TINGGI
STRAITS OF MALACCA
SUMATRA
S'pore
RIAU IDS
50
100
150
miles

MALAYA

⊙ *Sites of recorded occurrences of* ***Sus barbatus*** *in the Peninsula.*

NOTE.—A mountain backbone runs down the middle of the Peninsula, altitude up to 7,000 ft.

But this is not the end of the story. In 1939-40 a series of excavations were carried out in deposits in the limestone caves of Kelantan in the north of the Peninsula by the ethnological branch of the Museums Department. At Goa Madu the list of mammalian remains of Neolithic (recent) date includes the bones of both *Sus cristatus* and *S. barbatus.* As the Director wrote in August 1940 (vide *Journ., Royal Asiatic Society*, vol. xviii, Pt. 2 page 7)—the remains prove that the Bearded Pig is truly indigenous in the Malay peninsula. He adds that 'the species was only recently discovered in the Malay States . . . it had been suggested that the few known specimens are the remains of a herd imported by a former Sultan of Johor'.

A year or two later Singapore fell. So the riddle remains for the time unanswered.

PART II

So the known facts are that the Bearded Pig did inhabit the Peninsula, (certainly the northern part of it near the present Thailand frontier), in a Neolithic age which corresponded here probably to the early Christian era, and that it has in recent years reappeared in the south and east in small numbers. In the interval there is no record of it, though Malay lore has a semi-legendary monster, a lone boar of heroic dimensions existing in the forests, a travellers' tale. In Johor there are stories of a 'great white' pig seen by few. But nothing substantial is to be discovered. There is no record at all of any occurrence of this animal on the western seaboard.

The questions that arise are, is it, by its presence today, to be regarded as indigenous in the sense of being either a still established survivor of Sundaland, or as possibly re-establishing itself after a period of extinction?

The question of Survival.—What has happened to *barbatus* during the long period since it was hunted in Neolithic times, not so long ago? The wild pig is not an animal that readily conceals its presence. Most common and usually to be found on the fringes of cultivation, it is both a pest to be slaughtered at any time and the ordinary quarry of the hunter with his dog pack which exists in most villages for sporting and protective purposes. Old Chu'ah was one of scores of semi-professional hunters. Many hundreds or perhaps thousands are killed annually. It seems almost inconceivable that a race of wild swine such as the Bearded Pig with its signal characteristics could have escaped notice. When it has turned up it has provoked astonishment. Its habits do not seem to differ from those of the common *Sus cristatus* nor its natural terrain. *Barbatus* lives side by side in Sumatra with *cristatus*—and in the islands of the Raiu Archipelago—and it is not clear why it should have given way on the Peninsula. It has to be remembered that until quite lately, about fifty years ago, the ecological state of the Peninsula was still primeval, the population very small indeed and confined to the rivers and coasts. Nothing happened then or has since with the opening of the country that could affect its status.

There is, it is true, a large area in Pahang where the interior, covering a country about as big as Yorkshire, is mainly unexplored owing to its swampy and valueless nature, that may contain more specimens of this great pig but there is no known record of it whatever. Chu'ah who lived on the edge of it all his life never heard of it.

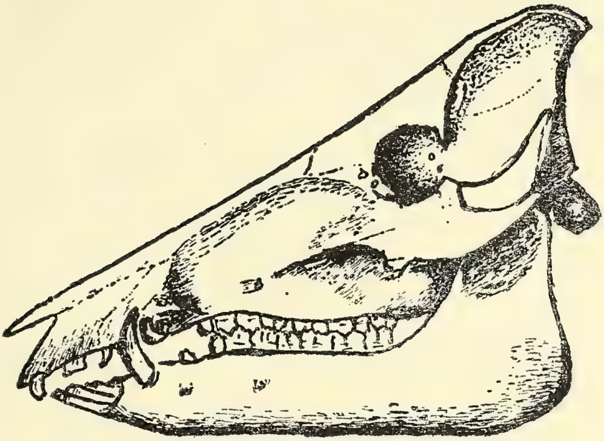
The question of Re-establishment. If it is not a survival, then the pigs presence in the past quarter of a century is due either to deliberate introduction or to that series of 'favourable circumstances leading to its establishment in small numbers' postulated by Moulton.

Introduction attributable to human agency may be considered first. It is well known that the distribution of the 'rusa' (the Malayan sambhar—*Cervus equinus*) has been affected over the archipelago by its planned introduction onto a number of islands, at one time slightly to the embarrassment of the zoographers of that tangled sub-region. But that there should be a similar dissemination by human agency of a detested and generally untouchable pest in numbers sufficient to found a colony is a very indigestible supposition. As regards the Johor story, historically, there have been two Sultans only in the past seventy years and the present ruler's predecessor was the Sultan Abubakar well known to law students in a leading case. He spent much time at the court of St. James and was a pious and erudite Mohammedan. It is difficult to believe that he or any other Sultan—Mohammedans all—would have taken the trouble to catch up and import a consignment of pigs which are regarded by Malays as nothing but foul and destructive vermin, for their specific difference. It is a pest too near home! Such an importation, it is considered, would have to be on a fairly big scale to form the nucleus of a population that in a short time spread 170 miles to the north. A few menagerie specimens for example, would seem inadequate. The Bearded Pig has, according to Shelford, some reputation as a migrant and in Borneo large numbers periodically move across country to fresh ground, due perhaps to pressure of local populations. The journey to Pekan where it was first shot by Dr. Leicester and Chu'ah, would involve a great deal more than 170 miles of direct travel and entail the crossing of more than one stretch of mountain country and several considerable rivers.

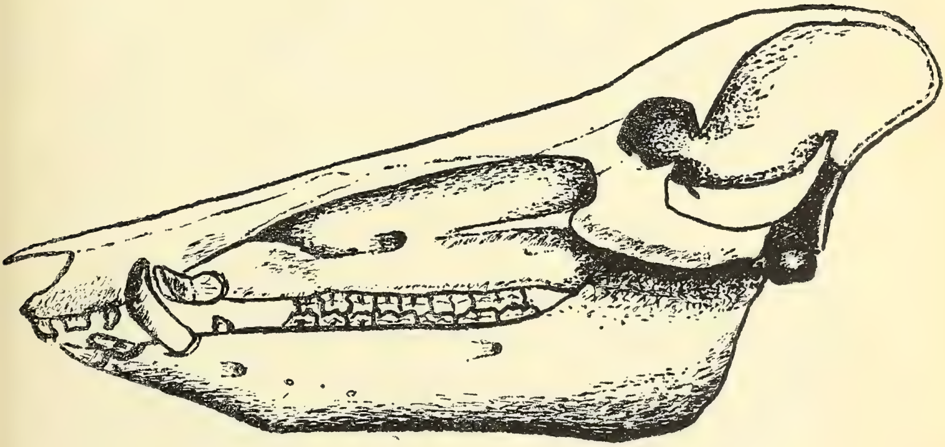
Still the story should be further investigated, though incredulity is felt as to its value.

What then is the likelihood of reintroduction by natural means —by the occurrence of those favourable conditions envisaged by Moulton?

The nearest islands to the southern tip of Johor (Cape Roumania) are those of the Riau Archipelago with Pulau Batam lying some ten miles to the southward. Between lies the ocean passage from Singapore for China bound traffic—a stretch of tide rips and fast currents. Yet *given the right conditions* wild animals do cross wide intervals. Many, including the wild pig are excellent swimmers. After the great floods of 1927 when the rivers in Pahang rose over sixty feet and inundated huge tracts of country, many wild animals were washed out to sea, pigs among them, and a tiger too, (one was found swimming five miles offshore). One pig of the *cristatus* species arrived on the island of Pulau Tinggi ten



Sus cristatus ×¼



Sus barbatus ×¼

Comparative dimensions of skulls of *s. cristatus* and *s. barbatus* (average adult male).

	Upper length.	*Basal length.*	*Least intraorbital breadth.*	*Zygomatic breadth.*
+ *Sus barbatus.*	447 mm.	428 mm.	75 mm.	182 mm.
Sus cristatus.	361 mm.	323 mm.	74 mm.	155 mm.

+ The specimen sent by J. E. Kempe to the Raffles Museum in September 1921.

miles off the Johor coast where it is not usually an inhabitant, either by swimming or on drift wood. Such events are phenomena —so rare as to become almost historical, and need abnormal circumstances such as a great flood to produce. Such favourable conditions as this could not occur on the small islands of the archipelago. Still the swimming ability of the pig is not to be taken lightly, and they are known to cross from one adjacent island to another in the Riau group.

The floating 'islands' of vegetation which are such features of the Straits of Malacca at certain times (but not, it be noted, of the Eastern sea-board,) are also suggested vehicles of distribution. These have as their nucleus as a rule the nipah palm (*Nipa fruticans*) which grows in brackish water and is not securely rooted. Given floods or abnormal tides, fringes break off and drift out to sea. Sometimes they are a rood or two in area. That they sometimes carry such animal life in their wanderings as tree shrews and rats is undoubted. As vehicles for anything greater and heavier, these 'islands' have limitations and the transport of anything as big as a pig (or as sagacious) must be exceedingly rare. It is to be doubted if even the crab-eating monkey of the mangrove swamps (*Macacus cynomogus*) is often a passenger. The islands become waterlogged at sea, float half sumberged for a time and eventually break up into fragments. It would be interesting to know what evidence there is, if any, of the larger mammals being found on one of these rafts.

As a potential agency in natural distribution, it is felt that this and the other phenomena referred to can be very easily overrated. The conclusion drawn is that the presence of *barbatus* on the Peninsula is unlikely to be due to a fortuitous supply from outside, (leaving aside the possibility of a few individuals having been introduced by the abnormal agency referred to before), even by a series of most favourable but not easily imaginable circumstances.

It follows that this pig has been with us all the time and that for some as yet unknown reason, it has only revealed itself on a very few occasions. That it must be low in numbers and very local is unquestioned though why, it is not understood.

That again leaves the major problem of its position so far out of its accepted frame still unexplained. According to the east and west 'drift' theory of Indo-Chinese (Himalayan) species which entered Sundaland from the north, suggested by Chasen in his foreword to the list of Malayasian mammals (Bulletin Raffles Museum: Vol. 15: 1940), some reached Sumatra and turned north whereby the Peninsula fauna from the western drift received additions *Sus barbatus* may easily have been amongest their number. In which case some explanation is needed why it should have lingered on in such obscurity as it is thought to have done, to be rediscovered in isolated and far separated localities after long intervals.

The facts as at present known are incomplete and further careful search may yet reveal small colonies surviving, while a closer study of the Bearded Pig's habits and environment in Borneo and Sumatra may help to elucidate the reasons why it has virtually disappeared as a common feature of Peninsula fauna.

AN ORNITHOLOGICAL PILGRIMAGE TO LAKE MĀNASARŌWAR AND MOUNT KAILĀS.

BY

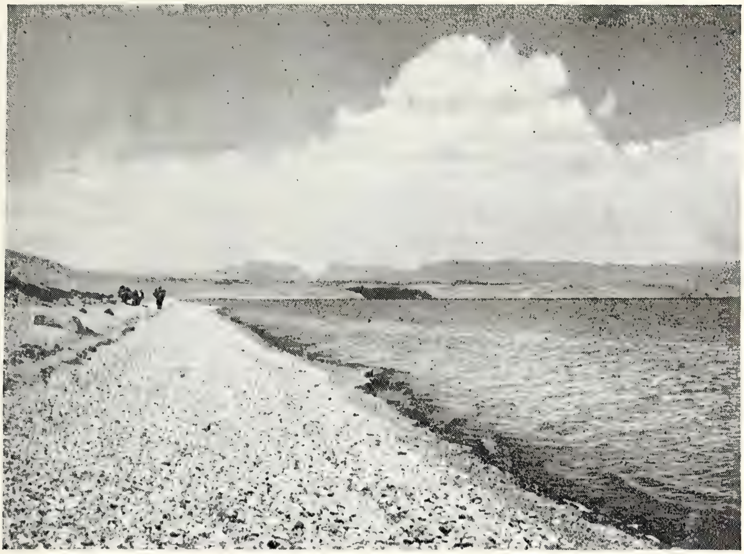
SÁLIM ALI

(*With a map and 7 plates*).

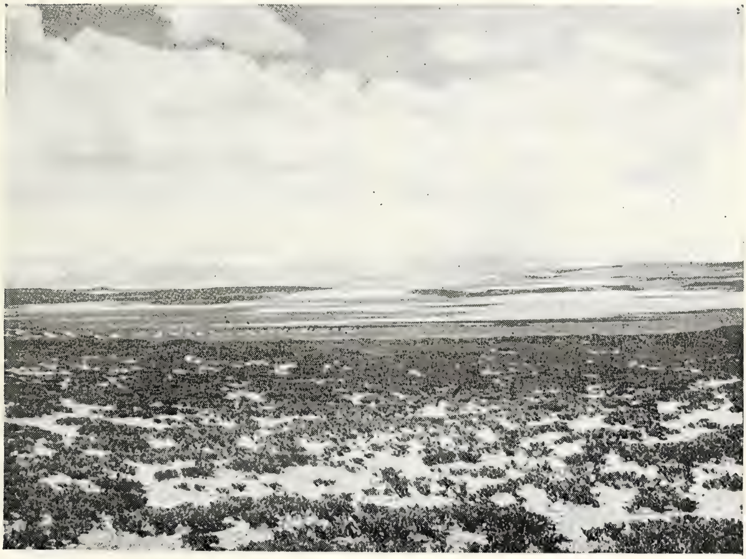
The hallowed region of the freshwater lakes of Mānasarōwar and Rākhas Tāl, and of Mount Kailās in Western Tibet is virtually forbidden ground to Europeans. It is perhaps for this reason more than another that practically nothing has so far been recorded about its birds. The time-honoured legend about 'hansa'; ('Swans' according to pilgrims' guide books) living on Mānasarōwar somehow persists, and in the popular mind these birds have become inseparable from the sacred lake. But reliable published information concerning the general ornithology of this region is lacking, although some excellent papers have appeared within the last 20 years or so on Ladakh as well as on Eastern Tibet by Osmaston, Meinertzhagen, Ludlow and others.

Mr. Frank Ludlow, who probably knows more about Tibetan birds than any other ornithologist living, made a small collection in Western Tibet in September-October 1932. The late Hugh Whistler pronounced it to consist of typical Tibetan Plateau forms, not differing from those occurring in Ladakh on the one hand or in the neighbourhood of Lhasa on the other. Ludlow never published any report of this trip, but has now been good enough to let me see his MS notes and to permit me to incorporate them in the present account. I consider it fortunate to be able to do so for 2 reasons: firstly because up to a point his itinerary coincided with my own, and secondly because his notes cover a period which is almost exactly complementary. Ludlow's trek was much more extended than mine, but I have here utilised only such of his notes as relate specifically to the region visited by me. While there is nothing novel or unexpected in the list that follows, it seems desirable to put this precise data on record for the benefit of future visitors.

What primarily attracted me to Mānasarōwar was the opportunity to study the natural conditions under which birds live on the Roof of the World, to ascertain at first hand what species breed in that area, and to determine if possible some of the ecological factors that foster their doing so. Although not interested in birds purely from what may be called the 'subspecific' point of view, I nevertheless feel it a great pity that practically no collecting could be done in an area that is so seldom visited by an ornithologist. I was advised by those who administered our External Affairs not to carry a gun to shoot birds with. Presumably it offends the religious scruples of the Tibetans to see birds killed by other people. None of these scruples were detected in the case of animals killed by themselves, and in a manner

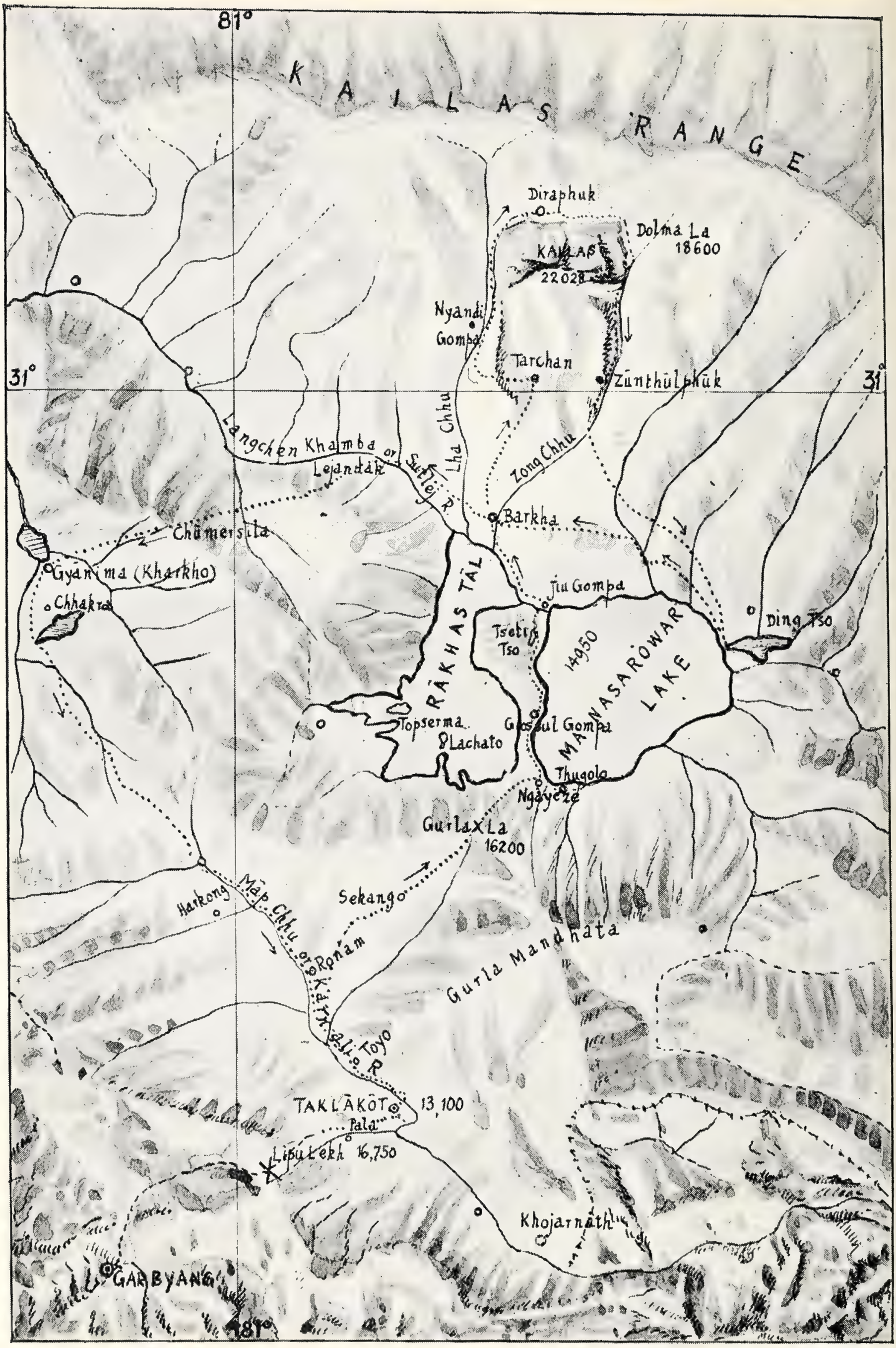


Western shore of Mānasarōwar with Mt. Kailās in background (showing Shore or Beach zone)



Copyright *Sálim Ali*

Rākhas Tāl with typical Kyang country in foreground


81°
KAILAS RANGE
Diraphuk
Dolma La
18600
KAILAS
22028
Nyandi
Gompa
Tarchan
Zunthulphuk
31°
31°
Langchen Khamba or Sutlej R.
Lejandak
Lha Chhu
Zong Chhu
Barkha
Chumersila
Gyanima (Kharkho)
Chhakra
Jiu Gompa
Tsetr Tso
RĀKHAS TĀL
14950
MĀNASARŌWAR LAKE
Ding Tso
Topserma
Lachato
Gosul Gompa
Thugolo
Ngayeze
Gurla La
16200
Harkong
Map Chhu or Karnali R.
Sekango
Ronam
Gurla Mandhata
Toyo
TAKLAKOT
13,100
Pala
Lipu Lekh 16,750
Khojarnath
GARBYANG
81°

(*After Heim & Gansser*)

The Kailās-Mānasarōwar Region of Western Tibet

Scale 1″ = *ca* 20 miles

Route............

that would make shooting seem a kindness. However, that is another story. But in the absence of skins for verification, some of my identifications may have to be taken with reserve, particularly in cases where they are at variance with Ludlow's.

I must confess that I have seldom felt sorrier for being so law-abiding and following official advice. Not only was much valuable scientific material lost without a gun; not only would an occasional roast goose have provided welcome change from the eternal dāl and rice; but also the couple or ugly encounters with local bandits that infest the Manasarowar environs could have been faced with far greater self-composure and dignity! As it was, either of these might well have ended in disaster had the bandits suspected the astonishing truth (for those parts) that the party was completely unarmed.

To enable me to be there in time for the nesting, a start had to be made as early in the season as the snow on the Lipu Pass would permit. The pilgrim season proper does not commence until about August. My trek began at Almora on 14 May 1945 and ended at the same place on 22 July. Up to the Tibetan frontier, crossed on this route by the Lipu Lekh Pass at 16,750 ft., it is a matter of about 16 marches—nearly 160 miles. Baggage over the first 14 marches travelled cooly-back. The regular trace takes a north-easterly direction from Almora and passes through some picturesque Himalayan scenery with superb views from various places along the route of Nanda Devi, Nanda Kot and the Panch Chuli peaks. For more than half its latter length it follows the right bank of the torrential Kali River which forms the boundary between the Kumaon district of Almora and the kingdom of Nepal. At Lipu Lekh the Kali is run to its source. The trek, commencing at about 5,200 ft. altitude (Almora) goes through an unending series of steep ups and downs. The lowest point ever touched in the course of the 160 odd miles is 2,200 ft. where the path crosses the Gauri Ganga River. Thus it furnishes a cross-section through an altitudinal range of some 14,000 ft.—from the warm subtropical jungles of the Himalayan foothills through various climatic and vegetational zones, up to above the limit of tree growth. The accompanying changes in the bird life as one crosses from one altitudinal zone or stratum to another are often so clear-cut that using them as indicators one soon learns to hazard a fair guess of the approximate elevation even without the help of the aneroid. It is this constant change of levels and the meetings and partings with new or familiar birds that to my mind makes trekking in the Himalayas so particularly delightful.

On 8 June the Lipu Lekh Pass was still under fresh and fairly deep snow. It had to be crossed in the unearthly hours of the morning while the surface was still hard and passable for the baggage ponies which had replaced the porters at Garbyang. After groping our way uncomfortably over boulders in pitch darkness with the dubious help of 2 miserable electric torches, the summit of the pass was reached at 6.15 hours just as the sun peeped out from over the barrier of mountains to the east. Here, among the cairns or piles of Mani stones, contributed laboriously one by one by grateful pilgrims and wayfarers (such as mark the head of every mountain pass in Tibet) was my first meeting of the trip with the Robin Accentor (*Prunella rubeculoides*). The birds—two or three—were delightfully tame; they hopped unconcernedly on the snow within 4 feet of our cavalcade, picking up food. This was also my first introduction to the amazing confidence and complete lack of fear that was henceforth to be experienced from almost every species of bird in Tibet. Such behaviour came strangest of all from the Bar-headed Geese and Brahminy Duck which, as every shikari knows, are amongst the wariest and most wide-awake of our waterfowl in their winter quarters in India.

Immediately across the pass the character of the country, now Tibet, changed abruptly. Trees of course are non-existent here, but other vegetation was also exceedingly scanty wherever the dry stony slopes were free from snow. Only small patches of low shrubs of Doma or Tibetan Furze (*Caragana spinosa*) clung here and there to the mountainsides, otherwise completely bare and scree covered. The route from Lipu to Taklākot runs all down the right bank of the river—the opposite number of the Kali, as it were—which rises on the Tibet side of the pass, the latter being the watershed. This river descends in a gently winding course for about 4,000 ft. in the 12 odd miles to Taklākōt where it joins the Māpcha or Karnāli. The latter, after flowing a great part of its length through Nepal territory in a N-S direction joins the Gogra in the Khēri District of the U.P. just south of the Nepal boundary.

Tāklākōt or Purang (*ca* 13,000 ft.), the first village of any size to be encountered, is a large and important *mandi* during the summer months. Traders from all parts of Tibet as well as from British India foregather here between June and November to barter wool, furs, borax and other indigenous produce with cloth and other articles of civilisation which appear to have a growing demand. Among these I noted as part of the standard stock-in-trade of Indian shops: cheap electric torches, new and second-hand army boots and plimosles, packets of tea from Lhasa and Berenag, sugar (misri), pots of highly scented vaseline pomade, safety pins and a miscellaneous assortment of tawdry nick-nacks requiring a high degree of imagination on the part of the shopkeepers.

One of the first indications that one has left Indian soil and is now in a different ornithological region is provided by the pigeons, which here suddenly change over to the Turkestan Rock Pigeon (*Columba rupestris*). This species is easily distinguished from our familiar Blue Rock by its whitish underparts and a broad white bar across its tail. Flocks of these birds were to be seen gleaning in the fields of young barley and gram surrounding the village. A few often visited our camp to pick up what grain they could round the kitchen tent. They were as tame and trusting as their pampered relations in the midst of Bhulēshwar (Bombay) for example, and other centres of Hindu benevolence.

The Tibetan Raven (*Corvus corax tibetanus*) takes the place of Jungle and House Crows as the village scavenger, though it is seen in smaller numbers. Skylarks—apparently Alauda *gulgula lhamarum*—were soaring and singing plentifully above the cultivation, while Red-billed Choughs (*Pyrrhocorax pyrrhocorax*) grubbed away merrily on the outskirts. The House-Sparrow—presumably *P. d. bactrianus*—was here in some numbers, but not as abundant as I was to find it on the return visit a month later.

At Taklākōt the 6 baggage ponies were exchanged for 4 yaks. And here a short digression may be permissible. The yak is an extraordinary beast. From infront it looks like an overgrown bear; from behind like a very shaggy hill pony. It possesses boundless energy, and seems impossible to tire out except when the weather is hot. It is highly sensitive to and impatient of the heat which seems to be the only element that will ever lower its spirits. At the end of a long fatiguing all-day march, carrying on their backs 2 maunds (160 lbs.) of often the most angular and uncomfortable load, and with just a few mouthfuls of scanty grass snatched while we halted for the mid-day meal, our yaks would frisk and romp obviously feeling 'as fresh as a daisy'. It was disconcerting when ebullience of spirits prompted one to buck and throw your baggage—boxes containing delicate and precious meteorological instruments that, moreover, didn't belong to you! A bridge is anathema to the yak. It is not every animal that will walk over it. Neither is it every day that even the same yak will consent to walk over one. There may be some justification for its preferring to leap into an icy cold torrent and swim across rather than use the highly unconvincing ricketty wooden structure swaying perilously above it. One is frequently tempted to do so oneself. But the soaking is not always beneficial for your baggage, particularly when this happens to be your bedding or warm clothes. Luckily bridges are few in Tibet. The yak has an unpredictable temperament, and you never know beforehand how one is going to react to any given set of circumstances.

The mountains here are chiefly composed of conglomerates—large quantities of rounded water-worn shingle cemented together with clay through age and pressure. Large detached blocks littered on the hillsides that look like enormous boulders in the distance are also composed of the same conglomerated clay and shingle, reminding one of chunks of almond rock. All the way from Taklākōt to Mānasarōwar the country is flat stony desert, the ground surface being chiefly covered with smooth water-worn stones, shingle or gravel—partly disintegrated from the mountains. Broadly speaking it is a titanic undulating steppe mostly between 14 and 15 thousand feet above sea level, extending miles in every direction and fringed on the near or distant horizon by snowy ranges and peaks. The enormous flat or gently sloping areas from the foot of the Gūrla Mandhāta Range to northward bear evidences of becoming vast snow-fields in winter. The stones, gravel and shingle on them are flattened down as by a steam roller. A curiously similar formation was noticed by me on the hills around Chāduva in Kutch (1943) but the stones there were all flat like paving slabs. What can that be due to?

From time to time flat-sided trough-like valleys are encountered as of glacial origin running down from the flanking hills. Through these meander rivulets from the melting snows higher up. About the banks of these rivulets, where the snow has melted, there is usually some scant herbage—a narrow strip of it on either side. This is the only green to break the drab and endless monotony of the stony landscape. The few birds that there are, concentrate in such places. Occasional low dense bushes of Doma or Tibetan Furze on the plateau, either isolated or scattered in patches, provide the only relief to the eye. They are sprawling and round-topped, like large hedgehogs, streamlined on their periphery near the ground. Dotted about on a gentle slope in the distance, they often look like a flock of grazing sheep.

A very characteristic facies of this region is that which occurs in the flat open valleys sloping so imperceptibly as to impede drainage and cause water-logging. At the season of my visit (first half of June) these showed traces of having been enormous snow-fields till recently, and extensive patches of snow were still lying about here and there. Where the snow has melted is often exposed a varying extent of semifloating spongy uneven humps, up to 12 inches high, covered with what looks like close-cropped lush grass. Such areas become tundra-like bogs. In portions the humps though green and refreshing are comparitively dry. In other parts the ground is completely soggy and water-logged, and they are in effect an archipelago of miniature islands or aits.

Almost everywhere around such tundra bogs the Lesser Pamirs Sand-Plover (*Charadrius mongolus atrifrons*)—familiar to us in winter on the western seaboard in flocks and now in his handsome summer dress—was sure to be met with. Surrounding these bogs there is usually a luxuriant growth of furze 'hedgehogs' which afford some protection from the violent winds and are much patronised for nesting in by Robin Accentors, Rubythroats and Tickell's Willow-Warblers. Everywhere on the stony gravelly plateau, even in the barest and most featureless spots, the Horned Lark (*Eremophila alpestris elwesi*) was breeding in great abundance. It has remained a puzzle to me why this bird chose the bleakest spots for its nest and what considerations decided the selection of a site. It seemed completely unperturbed by the wind and its nests were usually in the most exposed places. Occasionally they were near a tiny stone, it is true, but I am inclined to think that, if anything, this served more as a landmark to the bird than as an effective wind-break.

Immediately on crossing the summit of Gūrla Pass (16,500 ft.)—wide and flat enough I imagine, for 200 Churchill tanks abreast—the first view is obtained, glorious and breath-taking, of the twin lakes of Mānāsarōwar and Ŗākhas Tāl with the ice-covered dome of Mt. Kailās towering in the distant background to the north. The lakes are separated by a ridge of low hills forming an isthmus, 3 or 4 miles at its widest. Along this lies the route to Barkha Plain and the holy mountain.

My first camp on Mānasarōwar was pitched at Ngāyezē (*ca* 15,200 ft.) on the S-W shore of the lake. The water surface of Mānasarōwar is 14,950 ft. above sea level. It is 54 miles in circumference and surrounded on all sides by mountains, many of them well over 20,000 ft. high with snow-covered tops. The greatest depth sounded by Sven Hedin in 1907 was 269 ft. The colours on the lake, changing not only with time of day but with every fleeting mood of the sky are a thing undescribable, and not likely ever to be forgotten. From almost snow-white, may be, at one end, it ranges to every imaginable shade of green and blue—and from the deepest jade and the purest emerald to intense ultramarine blue and purplish-black.

A scrutiny of the terrain on the southern and south-western shores of the lake reveals an interesting range of successions. There are no reedbeds at all about the margins of Mānasarōwar or Rākhas Tāl, or indeed of any of the other lakes visited.

At the water's edge is a flat Shore or Beach zone of sand and shingle; higher up this gives place to a wider zone (in places 2 to 300 yards wide) of 'tundra' bog as described—spongy water-girt humps interspersed with small pools. Above the tundra zone follows another wide belt, of dense furze hedgehogs formed by a windblown accumulation of debris caught up in the bushes resulting in raised mounds at their core. These sprawling hedgehogs are 18 to 24 inches high and sometimes cover the ground so thickly as to hinder one's progress. Beyond the furze zone the flat bare ground is covered with loose stones and shingle, flattened down to evenness by the weight of the overlying winter snow. It stretches upward in a gentle sweep for 1 to 1½ miles, to the base of the Gūrla Māndhāta Range. The Shore and 'Tundra' zones, particularly where they meet, are riddled into a sieve with holes and galleries of voles and mouse-hares. As can be imagined, these four zones are not clear-cut or sharply demarcated along their boundaries and frequently dovetail into their neighbours, but they are distinct enough to be perceived without difficulty. With the exception perhaps of the Beach zone—a speciality of Mānasarōwar and Rākhas Tāl—the same order of succession with minor local variations is met with also on the smaller lakes: Ding Tso, Tseti Tso, Gyanima Tso, and others.

Adam's Mountain Finch (*Montifringilla nivalis adamsi*) as well as its two cousins *M. blanfordi* and *M. ruficollis* were everywhere taking full advantage of the rat holes as nest sites, and quite a few were observed carrying food into them. The tundra around the lakes seemed to be breeding ground *par excellence* of the Large Calandra Lark (*Calandra maxima*). Hundreds of these birds were busy courting, chasing one another, singing and nest-building round Mānasarōwar, Tseti Tso, Ding Tso and Gyānima Tso. Short-toed Larks (*Calandrella acutirostris*) were also present in the tundra zone at Mānasarōwar in large numbers. This was somewhat puzzling at first, but it was soon discovered that they visited the bog merely for collecting insects for their young, and flew off with beakfuls long distances to the bare stony country above the furze belt where they were nesting.

The principal inhabitants of the Furze zone were the Ruby-throat (*Calliope*), Robin Accentor (*Prunella rubeculoides*) and Tickell's Willow-Warbler (*Phylloscopus affinis*). Higher up, on the stony and gravelly plain, Horned Larks and Short-toed Larks were nesting abundantly, and the jolly little Hume's Ground Chough frequently seen.

At the time of my visit to Mānasarōwar and Rākhas Tāl the snow had not been gone long, and it was as yet too early in the season for the lush grass which is said to spring up luxuriantly on the moist areas later—mid July or August. Great herds of goats, sheep and yaks are then brought here for pasture from distant parts.

Curiously enough, except for an occasional sand-plover or two, no waders at all were to be seen at the water's edge in the Shore or Beach zone of Mānasarōwar. Their place appeared to be filled by Brandt's Mountain Finches (*Fringillauda brandti haematopyga*). Hundreds of these birds ran about the water-line looking very like stints, busily picking seeds washed up by the ripples. Sometimes the birds were in ones and twos, but mostly in flocks of 50 or more. They had evidently not commenced to breed as yet.

Of the waterfowl Bar-headed Geese, Brahminy Duck and Goosander were the most prominent representatives, the first two in considerable numbers. The geese, it seemed fairly certain were not breeding in the immediate neighbourhood. Their favourite nesting ground is on two boggy islands in the Rākhas Tāl, but without a boat it was not possible to explore these. A mixed flock of over 50 duck was observed on the water as they flew over, but it was difficult to tell with certainty what they were besides the few Gadwal and Pintail which were unmistakable. They were evidently not meaning to breed here either. Crested Grebes were abundant and numbers of their floating nests dotted the water some distance from the shore, particularly on a small lagoon by the side of the main lake. Brown-headed Gulls, Tibetan Terns and a couple of Pallas's Fishing Eagles practically complete the list of birds seen about the southern end of Mānasarōwar Lake.

The Barkha or Parkha Plain which separates the Mānasarōwar and Rākhas Lakes from the Kailās Range to the north, extends for many miles in an E-W direction. It is a gigantic highland steppe or flat valley covered for the most part with gravel and scanty scraggy grass at present. It is said to afford rich pasture later in the season, especially along the banks of the many streams that leisurely meander across it on their way from the Kailās Range to Rākhas Tēl. Along the northern edge of the Barkha Plain the ground slopes gently southwards in a gigantic sweep from the base of the Kailās Range. This sloping zone, several miles in width, is covered more or less densely with bushes of Doma or Tibetan Furze. Its surface consists of soft lose sand in places, and in others of coarse river sand with stones and shingle intermixed. It is cut up here and there by deep or shallow ravines of streams coming down from the Kailās Range. The sandy Doma-facies is strongly reminiscent of bits of the Indian Desert in Sind or Kutch, only the *Capparis* of the latter being here replaced by furze. The windblown sand is arrested in the same way by the furze bushes and forms compact mounds, but seldom higher than 12 or 18 inches. This facies, particularly in the environs of Rākhas Tāl, is the favoured habitat of the Kyang (*Equus*) which flourishes in large herds of up to 100 or more. The Barkha Plain can be differentiated into several other facies

Barkha Plain
Dry bogland and gravel facies

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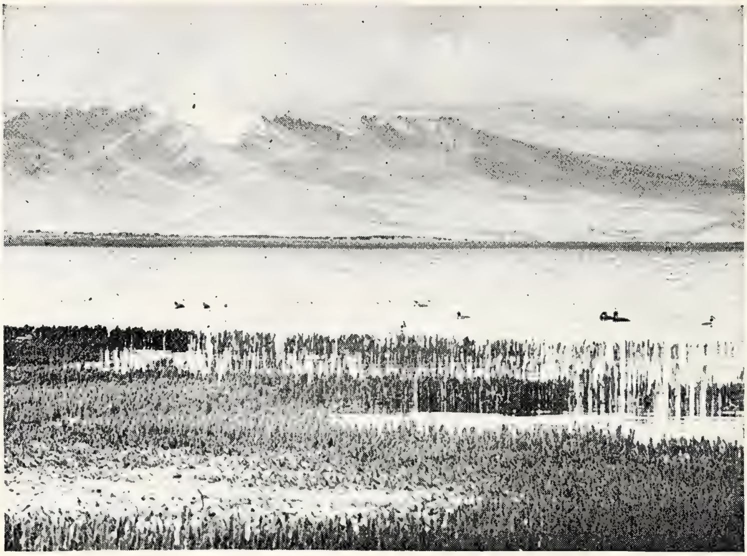
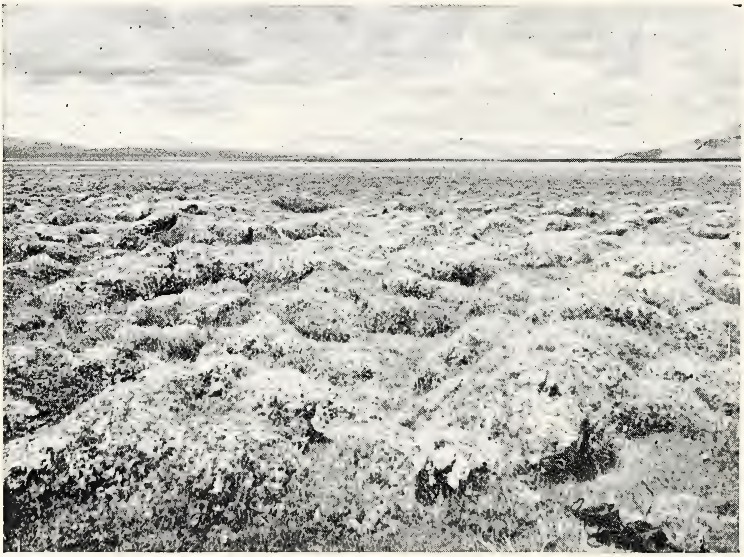
Barkha Plain
Sandy *Doma* facies



Ding Tso
Breeding place of Brown-headed Gulls, Tibetan Terns, Redshanks, Black-necked Cranes, Eared Grebes, etc.



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A typical ' tundra ' bog—Gyanima Tso
Breeding ground of Bar-headed Geese, Large Calandra Larks, etc.

besides: Loose-sand covered with sparse grass; coarse, roughly waterworn gravel and stone; and dry bogland. The last consists of uneven dips and mounds of crumbly earth reminding one of old worn-down flamingo nests.

Marching over the plain, one is constantly crossing from one into another of these facies. Wherever near a stream or its flat overflow, i.e. ground actually moist or till recently water-logged, it is honeycombed by mouse-hares to such an extent that one of the baggage yaks suddenly sank down to its belly. *Montifringilla blanfordi*, *M. ruficollis* and *M. nivalis* are invariably present in such facies to take advantage of the potential nest-sites. The birds and rodents evidently live together amicably. I observed a finch go down a burrow with food for young, followed soon after by a mouse-hare. Young finches when fledged, but while as yet unable to fly, come out of the tunnels and sit about and hop among the mounds where the parents feed them. On alarm they bolt down the nearest rat-hole and are evidently not molested by the occupant within.

In the flats formed by what may be called the deltas of the streams before they discharge into the Mānasarōwar and Rākhas lakes, the Doma gives place to extensive patches of a greyish-green bush about 12 inches high, known in Tibetan as *Tarwa* and in Kumaoni as *Chookoo*. These bushes apparently die down in winter and were just beginning to come up again (in June) on the melting of the snows.

The official pilgrimage of Mount Kailās begins at Tarchan or Darchan (alt. 15,500 ft.), a ramshackle village of a few hovels of piled-up loose stones, with a Gompa or monastery and attendant filth as its centre-piece. It also boasts of a small *mandi* open in summer but now lying derelict. The circuit of the holy mountain is 28 miles round and involves the crossing of a pass (Dolma La) 18,600 ft. high. Furze growth peters out at about 16,000 ft. and above this elevation perennial vegetation is practically non-existent. Bird-life along the entire circuit—in fact above 15,000 ft. altitude—was poor, but this may partly be due to the fact that I was much too early in the season. Places that had been recommended to us as rich alpine pastures and flower meadows were as yet little more than bleak and desolate snowfields dotted with recently melted patches here and there where the first hesitant spring herbage was beginning to peep out.

Except for Redstarts which were particularly abundant and nesting among the scree fans near Diraphūk or Diripu, a few pigeons and ravens about the Gompa there, a Robin Accentor with nest and eggs on the edge of a partly frozen stream, several Red-billed Choughs, and a couple of Himalayan Griffons and Lämmergeiers beating majestically over the hillsides behind the monastery, practically no birds were seen. A couple of pigeons were encountered on the very summit of Dolma La, attracted there by the grain sprinkled according to custom by pious jātris in thanksgiving for the culmination of the arduous climb.

The Lha Chhu and other part-frozen streams on the holy circuit looked ideal for White-capped and Plumbeous Redstarts, but these familiar Himalayan species were completely absent. On the Tibet side of Lipu Lekh Pass I also failed to come across the Whistling Thrush, so common along the Kāli River on the Himalayan side, almost right up to its source.

Horned Larks nest on the Barkha Plain in great profusion, both in completely barren and desolate spots as well as where there is a scanty growth of stunted furze. Short-toed Larks are more partial to the latter facies. Ground Choughs, Tickell's Willow-Warbles and Redstarts evidently prefer the side valleys where earth banks for nest-holes are readily available, and where there is more protection from the ferocity of the regular diurnal winds.

The Ding Tso lake proved a particularly fruitful place for birds. From the cosy comfort of the sleeping bag, and without raising my head from the pillow, could be watched through the open fly of the tent almost any time of day, numbers of geese, cranes and Brahminies as they sauntered about and grazed complacently on the grassy margins of the lake and in the surrounding marsh, within easy shot-gun range. My diary records: 'Delightful, but oh for a .22 and roast goose on the menu!' Along its eastern and northern shores is an extensive tundra belt 3 or 4 miles long and in places fully ¼ to ½ mile broad. Many of the uneven spongy humps here are actually floating, and separated from each other by a good long jump over deepish water. One had to be nippy and constantly on guard lest the hump underfoot should disappear below the surface before one had time to jump across to the next. It was an uncomfortable and flustering feeling to find oneself suddenly down to the waist in ice-cold water and sinking steadily. It was necessary to plan out several jumps in advance, and decide quickly. And the possibility of quicksands here and there—against which I had been warned—added to the excitement of the game. However it was fascinating work, and the exploration of this marshy belt proved well worthwhile. I found breeding here not only Bar-headed Geese and Black-necked Cranes, but also Brown-headed Gulls, Tibetan Terns, Redshanks, Crested Grebes and Large Calandra Larks.

METEOROLOGY

To this sketchy and imperfect account of the country might perhaps be added with advantage a few notes on the meteorological conditions experienced in June.

Temperature: The minimum night temperatures varied between 28° and 38°F. inside the tent, being mostly in the neighbourhood of freezing (32°F). The maximum day temperature registered was 89° in the shade (once). Normally it ranged between 70° and 75°. In the sun it was often uncomfortably hot even without a woollen vest or jersey on, but liable to become chilly with great suddenness as soon as a cloud obscured the sun. These violent fluctuations, from roasting one moment to freezing the next, always made it difficult to decide how one should be clad for a march. Pull-overs had to be handy in the rucksac, and quick changes by the wayside (sometimes several in the course of a day) were not uncommon. Practically every day of the month the sky was party to heavily overcast for some part of the 24 hours, and light drizzle or hail (snowfall on one or two occasions) were frequent.

Barometric Pressure: This showed appreciable variation at the same place, and was frequently as much as 4 millibars higher in the morning than in the evening.

Wind: Except on a few memorable occasions when the blowing away of the tent from above our heads was all but imminent, the nights were comparatively windless. But except for a few comparatively windless days which could probably be counted on the fingers of one hand, the wind sprang up with great regularity soon after about 10.00 hours each day—occasionally after 14.00 or later—and raged and howled until 19.00 to 21.00 hours when it as suddenly died down. And what a wind it was too! Visitor after visitor to Tibet has execrated the fury of the diurnal gales, and with good justification. My weather diary records the normal velocity as No. 5 or 6 of the Beaufort Scale (i.e. between 17 and 27 miles per hour) and occasionally even No. 7 (28-33 miles) the latter causing considerable inconvenience in walking against.

Observations of humidity were also taken with a revolving Hygrometer, the lowest and highest figures recorded in Tibet during the entire trek being 26 and 89. All the data, meagre as it is, has been forwarded to the Government of India Meteorological Office in Poona, to whom I wish to express my thanks for their co-operation in loaning out the necessary apparatus.

Itinerary:

8-6-45.	Lipu Lekh Pass (16,750′) to Taklākōt.
9-6-45.	Taklākōt or Purang (ca 12,700′).
10-6-45.	Rangūng (ca 14,300′).
11-6-45.	Sekang (ca 15,300′).
12-6-45.	Sekang.
13-6-45.	Ngāyēzē (ca 15,300′)—S-W shore of Lake Mānasarōwar.
14-6-45.	Halt at Ngāyēzē
15-6-45.	Chheting or Tsering Madāng (15.000′)—8 miles up W shore of Mānasarōwar. Camp by Tseti Tso.
16-6-45.	Jiu Gompa (15,000′) North end of Mānasarōwar. Camp by Ganga Chhu—the channel connecting Mānasarōwar with Rākhas Tāl.
17-6-45.	Barkha (ca 15,100′).
18-6-45.	Tarchan (ca 15,500′) S of Mt. Kailās.
19-6-45.	Diripu or Diraphūk (ca 16,700′)—N of Mt. Kailās.
19-6-45.	Halt at Diraphūk.
20-6-45.	Zūnthūlphūk (16,000′)—E of Mt. Kailās, beyond Dolma La Pass 18,600′.
22-6-45.	Halt at Zūnthūlphūk.
23-6-45.	Pelūng Yōma (ca 16,000′)—side valley on N edge of Barkha Plain.
24-6-45.	Ding Tso Lake (ca 15,200′)—at N-E corner of Mānasarōwar.
25-6-45.	Halt at Ding Tso.
26-6-45.	Kyāngma (ca 15,200′)—near S edge of Barkha Plain.
27-6-45.	Lha Chhu (ca 15,200′)—Barkha Plain west of Barkha.

28-6-45. Lējandāk (ca 15,000′) also pronounced Lālenthāk. On S edge of Barkha Plain with a sprawling arm of Rākhas Tāl along the base of the low bare hills, and with tundra belt bordering it.

29-6-45. Chhūmersīla (ca 15,000′—pronounced Chhū-mi-shīla).

30-6-45. Gemoshīsa (ca 15,100′)—overlooking Gyānima Tso (lake) ca 3 miles to S.

1-7-45. Gyānima Mandi or Khārkho (14,900′)—with many square miles of tundra bog around Gyānima Tso.

2-7-45. Gyānima Chhakra (14,900′).

3-7-45. Shēlēkhookar—across Chhakra La or Chuppu La (ca 15,000′) N to S.

4-7-45. Māpcha Chhūngo (ca 14,400′)—source of Māpcha or Karnāli River.

5-7-45. Rōnām (ca 13,400′)—on left bank of Karnāli River. Down the Harkang 'lūmbo' (or river valley) luxuriant Doma on both banks of stream. Rubythroats nesting here in such abundance that I named it Calliope Valley. Also *P. affinis*. About 5 miles above its junction with the Karnāli, i.e. from about 13,800′ downwards, *Saxicola torquata* re-appeared, now mostly accompanied by squamated young ex-nest.

6-7-45. Taklākōt. Route N to S all down the left bank of the Karnāli.

NOTES ON BIRDS OBSERVED IN THE MĀNASARŌWAR-KAILĀS REGION OF W. TIBET 8 JUNE TO 8 JULY 1945

The Tibetan Raven. *Corvus corax tibetanus* Hodgs.

In small numbers—sporadic solos and pairs—scavenging in the precincts of monasteries or shepherds' encampments and 'goat-train' halting stations. Highest met: 16,700 ft. (Diraphuk, north of Kailas). In overhead flight the remiges look slate coloured, boldly set off by the jet black underwing coverts. Has a high-pitched voice. Its caws sound very like the call of the Tibetan Tern —*Kreeuk*—and they are varied by a soft *Pruk-pruk* etc. like a wooden cattle bell. Altogether quite an elegant performance for one of the tribe!

[Taklākōt, Barkha, Darchan. September 1932 F. Ludlow.]

The Yellow-billed Chough. *Pyrrhocorax graculus.*

The only examples seen were a couple at 16,000 ft. just across the Lipu Lekh Pass, in the main Himalayan range. In the mountain ranges further north, e.g. Mandhāta and Kailās, it appears to be completely replaced by the next species.

[Not seen in W. Tibet. September 1932 F. Ludlow.]

The Red-billed Chough. *Pyrrhocorax pyrrhocorax.*

Not uncommon but sporadic. Mostly pairs in early June, family parties early July. Young birds have brownish-red bill and pinkish gape. On cliffs, about cultivation and monasteries, by shepherds' encampments and goat-train bivouacs. Highest met: 18,000 ft. (near Dolma La, Kailās). Once a flock of over 60 attending large herd of Kyang miles out on the bare Barkha Plain. Call: a shrill cawing *Chiaow, chiaow* etc. An adult pair with two full-fledged juveniles observed retiring to roost in crevice of cliff—evidently nest-site—at sunset while still very light.

[Lipu Lekh, Taklākōt, Darchan. September 1932 F. Ludlow.]

Tibetan Raven

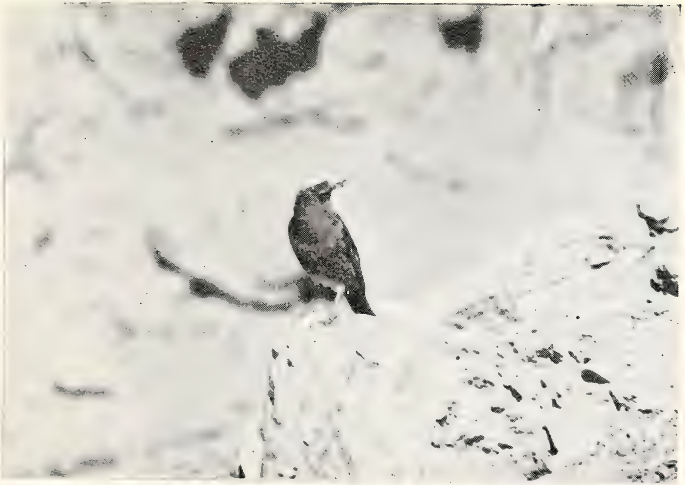
Red-billed Chough

Copyright

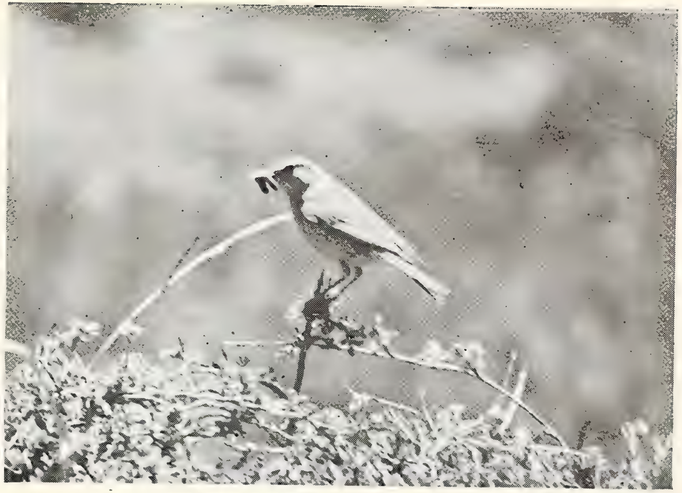
Nest site of Hume's Ground Chough

Sálim Ali

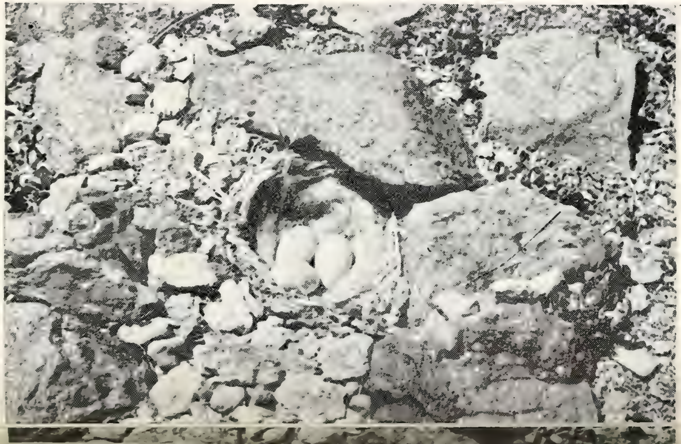
Hume's Ground Chough

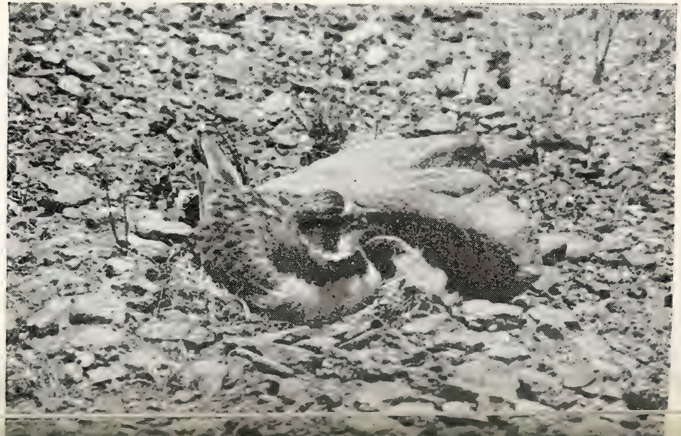


Redstart



Tickell's Willow-Warbler





Hume's Ground Chough. *Pseudopodoces humilis* Hume.

Quite common, generally in pairs or family parties of 4 or 5. Certainly one of the commonest birds in the Mānasarōwar-Barkha area. Highest met: ca 16,000 ft.—i.e. the limit of furze growth. Evidently commencing to breed early. Frequents screes or stone littered gentle hummocks and lower hillsides in preference to the bare open plain. Partial to the side valleys opening on the Barkha Plain, and here to dry watercourses with steep outscoured earth banks. Hops about amongst loose littered stones, pulling them over with its curved bill or digging vigorously for insects. Mounts a stone every little while, or occasionally a furze hedgehog, to bob violently a couple of times like a chat, but standing upright and not ducking its head. General appearance very like the Mountain Finch (*Montifringilla n. adamsi*) with the same colour pattern of tail —white outside feathers, brown middle ones—but no white wing bar. Twitches tail open laterally every now and again, and also shivers wings, especially while bobbing. The flicker of the white tail feathers in the distance is often the only indication of the bird's presence in its obliterating environment. Progresses on the ground with an upright carriage in long hops, bouncing like a rubber ball. When rummaging or digging among the stones, and also in flight (when the tail is spread exhibiting the white-and-brown pattern,) the bird reminded me strongly on the Large Grey Babbler (*Argya malcolmi*). The likeness is heightened by the slightly curved bill and the darkish lores. In other ways the bird is reminiscent of the Wood Shrike (*Tephrodornis pondiceriana*). Calls: The *Chip-cheep cheep cheep cheep* commonly uttered, is very like call of the Yellow-eyed Babbler (*Chrysomma sinensis*). There is a slight pause after the initial *chip*; the rest of the notes are quick-repeated. It also has a feeble whistling note like that of the Spotted Munia, but more prolonged.

Nesting: Nests in holes in earth banks, self excavated. One nest (22 June) was at the end of a horizontal straight tunnel in a steep earth bank 4 ft. long, and 3 in. in diameter. The tunnel ended in a widened chamber 9 to 10 in. across. The nest itself was an enormous pad of sheep's wool on a foundation of green moss and weighed over 1½ lb. It contained a clutch of 6 eggs, slightly incubated, immaculate white with translucent pinkiness, longish ovals only slightly narrower at one end. They measured: 23.5×17, 23×17, 24×17, 24×16.5, 24×16, 23.5×17 mm. At another nest containing young (24 June) both parents were observed entering with food and removing packets of faeces.

The bird does not alight outside the nest-hole before entering but 'helicopters' into it directly, vibrating its wings rapidly as it approaches the hole. For photographs the hole had to be temporarily blocked with a stone.

From much in its general get-up, habits and behaviour I should not be greatly surprised if a proper anatomical study revealed the correct taxonomical position of this bird to be in the Family *Timaliidae* (Babblers).

[Darchan, Diraphuk. September 1932. F. Ludlow.]

The Rock Nuthatch. *Sitta neumayer.*

I had a distant fleeting glimpse of a bird at 18,000 ft.—below Dolma La Pass—which may have been either this or *Tichodroma*. I set down the record here for what it is worth.

The Wall Creeper. *Tichodroma muraria.*

A pair observed on steep conglomerate crags flanking the river at Taklakot (13,000 ft.). The flight consists of flap—pause (with wings closed)—flap—pause, and so on; very butterfly like. In the distance, in uncertain light, general appearance confusingly like Rock Nut-hatch, both when creeping up a rock-face and on the wing.

The Brown Dipper. *Cinclus pallasii.*

A single bird on Karnali River at Rōnām, 6-7-45.

The White-breasted Dipper. *Cinclus cinclus.*

A solo on the partly frozen Lha Chhu at Diraphuk (16,700 ft.), and a pair in copula at Zūnthūlphūk (16,000 ft.)—both in the Kailas Range.

The Collared Bush Chat. *Saxicola torquata.*

Observed at Ngāyezē (ca 15,300 ft.—S.W. shore of Mānasarōwar), in the Harkang Valley (between 13 and 14,000 ft.) and a Rōnām. Numerous in Harkang Valley. Chiefly on and about water-logged ground. With squamated wobbly flying young in first week of July.

[Specimen from 'Rugong' (? Rangung) 5 September. *S.t. przewalskii* F. Ludlow.]

The Tibetan Desert Chat. *Œnanthe deserti* [*oreophila* (Oberholser)].

Observed at Taklakot, Toyo, Gurla Pass, Gossul Gompa, (W shore of Mānasarōwar), Lejandak, Ding Tso, Kharkho, Gyanima Chhakra. Highest ca 16,500 ft.

Not noted at all on Kumaon side of Lipu Lekh, from Almora.

Solos and pairs. Sporadic but frequent. Keeps to stony hummocks and hillsides covered with sparse furze bushes. Male has a pretty little song: *Teee-ti-ti-ti* repeated monotonously all day long in the vicinity of the nest, from a stone or on the wing. Occasionally hovers about 50 ft. up for over 5 seconds, and sings. Particularly favoured nest sites are in among the cairns of Mani stones and in the old piled-up clods of earth and turf which compose the walls of the seasonal *mandis* or market places, e.g. at Khārkho, and Gyānima Chhakra. Nest: a cup of mosses and goat hair etc. neatly lined with sheep's wool, ca 3½ in. in diam. Several broods of woobbly-flying, stub-tailed juveniles—3 in each case—fed and fussed over by parents in last week of June and first week of July. When a nest with young was approached the female kept flitting about excitedly, wagging her tail up and down and uttering *Chuck-chrr* presumably in warning to the young. She repeatedly attacked and drove off the male from the proximity when the nest was being searched for, as if apprehensive of his giving away the position.

[Often seen between Mānasarōwar and Gartok. Sept. 1932 F. Ludlow]

The Eastern Indian Redstart. *Phoenicurus ochruros* [*rufiventris* (Vieillot) ?].

Observed at Darchan, Diraphukh, Zūnthūlphūk, Pēlūng Yōma, Chhūmersīla, Gyānima Chhakra, Shēlēkhookar. Highest 18,000 ft. Pairs. Scattered, but locally numerous. Nesting in stone and boulder littered country at the base of mountains in Lha Chhu Valley and elsewhere' in Kailās range. Nests: cups of goat and yak hair—in holes in steep outscoured conglomerate or crumbling earth banks in side valleys opening on Barkha Plain. Found many nests with eggs or young—mostly 3. Wobbly, stub-tailed juveniles about in first week of July. One nest on ground among exposed roots of furze bush overhanging steep eroded earth bank of stream. Two nests at Zūnthūlphūk within 10 yards of each other watched for over an hour and a curious state of affairs noted. Both nests contained young but in one only a female was feeding, in the other only a male. Although these nests were in such close proximity and the birds frequently within a few feet of each other outside the nest—sometimes with food in bill, sometimes without—there was no rivalry of any sort observed. May it be that both the nests belonged to one and the same pair and that the male had taken over incubation in the first nest while the female laid again in the second? I cannot think of another explanation.

The race here is evidently *rufiventris* with practically no grey fringes to the black feathers of the upper parts. However, a specimen obtained by Ludlow at Rākhas Tāl, Sept. 1932, is identified as *P.d. phoenicuroides*. *Phoenicurus erythrogaster grandis* (Gould). Guldenstadt's Redstart.

'Common on the Kailās circuit between 16,000 and 18,000 ft.' September 1932. F. Ludlow.

The Rubythroat. *Calliope pectoralis*

Observed at Sēkang, Ngāyēzē, Shēlēkhookar, Māpcha Chhūngo, Rōnām. Nowhere in the Kailās circuit or north of the Barkha Plain.

Commonly nesting in furze bushes in the environs of lakes, streams and 'tundra' bogs. Numerous globular or dome-shaped nests of grass with lateral entrance, low down within furze hedgehogs, with eggs or newly hatched young (normally 3), in first half of June. Wobbly stub-tailed juveniles in 1st week of July. Eggs very handsome bluish-green or deep sea-green. Both sexes feed the young. All the birds I met were very shy and circumspect when approaching nest with eggs or young. The male sings constantly from the top of a furze bush in the proximity of the nest. The song is very similar to that of the Pied Bush-chat, and of 3 or 4 seconds' duration. It is repeated almost without a break—to the point of monotony—for half to one hour at a time. The singing stance is also as in that bird: tail loosely depressed, wings partly drooping at the sides. In one instance the singing day commenced at 04.10 and ended 20.30 hours, when the condition of the light was about the same as at start—almost dark. While singing, the brilliant ruby throat-patch scintillates catching the light at different angles in a remarkable way.

My notes make no mention of the white moustachial streak that distinguishes the Tibetan species *tschebaiewi.* I hardly think that such a prominent feature if present could have been overlooked, especially with binoculars and at close range. Therefore I feel that the birds I met were not *tschebaiewi* although this is the form recorded from Ladakh and the Gyantse neighbourhood. It is unfortunate that no specimens could be secured. A ♂ and ♀ obtained by Ludlow at Menga (14,300 ft.) further west, on Sept. 16, 1932 were identified as *tschebaiewi.*

The Blue Rock Thrush. *Monticola solitaria.*

Observed at Taklākōt, Toyo, Gemoshīsa.

Uncommon. Only 3 or 4 solos and 2 or 3 pairs sporadically during entire trek. One carrying food for young to rocky hillside, 30-6-45. The song of the male is rather like the Rubythroat's but longer and richer—with more of the thrush quality. In the breeding season it has a habit of singing as it volplanes gracefully along the contours of a cliff, very like a child's paper aeroplane.

The Robin Hedge-Sparrow. *Prunella rubeculoides.*

Observed at Lipu Lekh Pass, Sēkang, Rangūng, Tarchan, Diraphūk, Zūnthūlphūk. Highest 17,000 ft. Pairs in and about furze patches in the neighbourhood of snow-fed streams and tundra bogs. Tame and confiding. Hops about on ground like House-Sparrow, picking up food. Call: a feeble *Tililili.*

Breeding general in first half of June. Nest: a grass-lined hollow on the mound forming the core of a furze 'hedgehog', well concealed within the bush. This appeared to be the most usual site. One nest was placed in a hollow in the bank of a partially frozen stream. C/3 was the norm, the eggs being of the typical hedgesparrow blue, unmarked and very handsome.

The Garhwal Hedge-Sparrow. *Laiscopus collaris whymperi.* Stuart Baker.

Specimens obtained on Lipu Lekh by F. Ludlow, 2 Sept. 1932.

Tickell's Willow-Warbler. *Phylloscopus affinis* (Tickell).

Observed at Sēkang, Ngāyēzē, Tarchan, Zūnthūlphūk, Pēlūng Yōma, Shēlēkhookar, Māpcha Chhūngo, Rōnām. Highest 16,000 ft.

Abundant in dense furze facies especially on gentle lower slopes of hills flanking stream valleys, e.g. Harkang 'lūmbo' and Māpcha Chhūngo. In pairs, and breeding freely everywhere throughout June and first week of July (after which I left Tibet.).

Males sing constantly from bush tops: a loud *Pick—pick* (or only a single *pick*) *whiw-whiw-whiw-whiw.* Nest a ball of grass ca 6 in. × 4 in. with lateral opening near top, lined with soft feathers. Placed up to 2 ft. up in a furze bush. Norm c/4. Eggs of 2 types: (1) Pure immaculate white, (2) white sparsely stippled with rust-red especially at broad end. Average measurements of 6 eggs 16 × 12.5 mm. Numerous nests contained eggs in second week of June, and newly hatched chicks in first week of July. During the latter period also many wobbly juveniles were on the wing.

Both parents feed the young, and are circumspect when approaching the nest. In one case feeding continued till 20.30 hrs.—when almost dark.

['Obtained on the Lipu Lekh at 12,500 ft. and noted at Darchan' F. Ludlow Sept. 1932.]

The Rosy Pastor. *Pastor roseus* Linn.

A solitary straggler—adult in perfect summer dress—was observed among grazing ponies on lush grassland in the Karnāli river valley, between Toyo village and Taklākōt, 6-7-1945. This was the only example met with during the entire trip.

The Great Rose-Finch. *Carpodacus rubicilla.*

Observed at Pāla (ca 14,000 ft.) near Lipu Lekh Pass.

Quite common. Singly or in pairs on stone littered open ground.

[Ludlow obtained a specimen of *severtzovi* on Lipu Lekh and noted it as common at Taklākōt and Darchan. Sept. 1932]

The Red-breasted Rose-Finch. *Pyrrhospiza punicea.*

Observed at Tarchan, Lejandak, Pāla. Highest ca 15,500 ft.

Occasional pairs on bare rugged hillsides. Not common.

The Pink-browed Rose-Finch. *Propasser rhodochrous.*

Observed only at Pāla, ca 14,000 ft.—A flock.

The Goldfinch. *Carduelis caniceps.*

Observed only on the return journey from Gyānima, 6 to 8 July, between Harkang (13,500 ft.) and Taklākōt (13,000 ft.). In pairs, and fairly common. The period of its appearance and its varying local abundance seemed to be closely correlated with the sprouting after winter and varying local flowering of the Thistle on the seeds of which it was constantly feeding.

Ludlow observed Goldfinches at Taklākot in Sept. 1932, but took no specimens.

The Twite. *Acanthis flavirostris.*

Observed at Sēkang, Chhūmersila, Shēlēkhookar, Rōnām. Highest ca 15,000 ft.

In parties of 6 to 8 on screes and stony hillsides. Between 13 and 14 thousand feet appeared to be its optimum zone. Easily distinguished from other similar finches by its slender build and bill, pale pink rump (especially in the male), distinctly forked tail, and the *twite-twite* uttered in flight.

Ludlow found the race *ladacensis* common about Taklākōt in Sept. 1932.

The Gold-fronted Finch. *Metaponia pusilla.*

Observed only at Taklākōt both when I passed through in the first week of June and on my return visit in the 1st week of July. Parties in June, pairs in July, on open shingle screes. Utters a feeble but sharp *tree-tree* and also a musical *chiririri.*

[Noted at Taklākōt, Sept. 1932. F. Ludlow.]

The House-Sparrow. *Passer domesticus.*

Observed only at Taklākōt (13,000 ft.) and Toyo village, which might be called its suburb. None in the gompas or monasteries in the Mānasarōwar-Kailās circuit.

A number are said to spend the winter in the Taklākōt monastery situated on a hilltop about 500 ft. above the *mandi.* In early June while the *mandi* was still largely deserted I found fair numbers of sparrows occupying holes in the thatching of the monastery buildings. In July when the *mandi* was more or less tenanted by traders, sparrows were in much greater abundance here. Some of the birds had doubtless come down from the monastery, but the large numbers suggested that others had immigrated from elsewhere. They were nesting freely in the shop buildings in early July. Also noted in Sept. 1932 by Ludlow. Race *parkini* (=*bactrianus.*)

The Tree Sparrow. *Passer montanus.*

One very doubtful and unconfirmed sight record from the monastery at Tarchan (15,500 ft.) on a stony treeless hillside!

The (Tibetan) Mountain Finch. *Fringillauda brandti haematopyga* (Gould).

Observed at Ngāyēzē, Diraphūk, Chhūmersila, Gyānima Mandi, Pāla. Highest ca 17,000 ft. Frequent flocks on scree fans and stony hillsides all along the Kailās *parikrama*. Large numbers at water's edge on the S-W shore of Mānasarowar lake and on adjacent bogs, hopping or running about—looking very like stints in the distance—picking up seeds (presumably) washed up by the ripples. Sometimes only one or two individuals, at others dense flocks of 50 or more. No sign of breeding activity noted up to 2nd. week of July. Ludlow collected specimens on the Lipu Lekh and at Rākhas Tāl, and observed it on the Kailās circuit. Sept. 1932.

Stoliczka's Mountain Finch. *Fringillauda nemoricola* [*altaica* (Eversm.)]

Observed only at Pala (ca 14,000 ft.—near Lipu Lekh Pass). Fairly common. Small parties on bare stony hillsides and scree fans.

An ad. and juv. were collected by Ludlow on the Lipu Lekh in Sept. 1932.

The Tibet Snow-Finch. *Montifringilla nivalis adamsi* Adams.

Observed at Pāla, Taklākot, Ngāyēzē, Nyandi, Diraphūk and all along the Kailās circuit; Māpcha Chhūngo. Highest 17,000 ft.

Fairly common. Pairs, on open scree fans, stony ground about base of hills and snow patches. Breeding in June and July. Many entering or leaving holes in clay cliffs or burrows of voles and mouse-hares. Commonly seen flying with beakfuls of insects collected mostly at edge of water.

Ludlow obtained specimens—1 ad., 1 juv.—near Taklākōt. Sept. 1932.

The Red-necked Snow-Finch. *Montifringilla ruficollis* Blanford.

Observed at Kyāngma (Barkha Plain), Lejandak, Gyānima Mandi—all at ca 15,000 ft. Fairly common locally. In pairs on open gravel plain. Nesting in numbers in burrows of mouse-hares (*Ochotona*). Many part-fledged non-flying young sitting about outside burrows on hole-riddled ground, being fed by parents, in the last week of June. Other adults still collecting feathers for nest-lining at end of June. The birds apparently live on terms of amicable 'Co-prosperity' with the rats. A juvenile male caught outside a rat hole with rectrices and remiges in quill, had pale rose-pink undertail coverts. Iris grey-brown, bill ivory yellow, legs and feet slaty black.

Blanford's Snow-Finch. *Montifringilla blanfordi* Hume.

Observed at Ding Tso (N.E. of Mānasarowar) ca 15,000'.

Frequent. In pairs and evidently breeding. Seen by F. Ludlow at Barkha, 8 Sept. 1932.

The House Martin. *Martula dasypus.*

Observed at Rōnām and Toyo, ca 13,500 ft. A few hawking in Harkang 'lūmbo' (river valley) and over Karnāli river near Toyo village, 5 & 6 July. Not met with anywhere in June.

Ludlow also saw it at Taklākōt in Sept. 1932, but did not collect specimens.

Sand Martin. *Riparia riparia.*

Observed at Jiu Gompa, Barkha, Lejandak—all ca 15,000 ft.

Uncommon. Sporadic pairs near streams or small pools flanked by earth banks where presumably nesting. White or almost white on lower abdomen. Identity uncertain.

The Crag Martin. *Riparia rupestris* (Scop.).

Observed at Lejandak (S edge of Barkha Plain) ca 15,000 ft. and Toyo (near Taklākōt) 13,000. Uncommon. Pairs about cliffs flanking streams. On 6 July a pair were collecting mud at the edge of Karnāli River near Toyo and building about a hundred feet up on a rock face.

Taklākōt, Sept. 1932. F. Ludlow!

Hodgson's Pied Wagtail. *Motacilla alba alboides* Hodgs.

Observed only at Talākot (13,000 ft.). Ludlow collected a specimen near Zorāwar Singh's tomb at Rugong in Sept. 1939. 'Apparently the breeding bird on the plateau.' A pair, both with grey backs instead of black, was also observed a month later in the same locality on the Karnāli River and put down in my notes as *M.a. personata*. This, however, must be accepted with reserve in view of Meinertzhagen's categorical statement in the Ibis (1927) that Osmaston's record of *personata* in Ladakh must 'without doubt' refer to *alboides*. Osmaston's list (from sight) omits *alboides*, and Meinertzhagen who collected specimens never came across *personata* there!

Ludlow obtained a specimen of *personata* at Gartok, farther west in this area, on 24 Sept. 1932, presumably a migrant according to him.

The Yellow-headed Wagtail. *Motacilla citreola.*

Observed at Sēkang, Ngāyēzē, Gyānima Chhakra, Rōnām. Highest ca 15,300 ft.

Not common, but pairs frequent on water meadows and bogland. Males yellow-headed, black-backed; females grey-backed, with yellow forehead and supercilium. Evidently breeding.

Anthus sp: Pipit.

Ludlow obtained a specimen on the shores of Rākhas Lake on 6 September 1932, regarding which Whistler remarks 'I do not feel quite happy about this bird—it seems to be either *campestris* or *thermophilus*, and I should have said the latter only the hind claws are so short'. Ludlow had put this down in his field note book as *Anthus richardi*. He obtained specimens of this same pipit in Sept. and Oct. 1933 on the Phari-Gyantse road (Ibis 1937, p. 481) and also in S.E. Tibet in the autumn of 1936 and 1938 (Ibis 1944, p. 363). All these birds were fat and appeared to be on migration.

Elwes's Horned Lark. *Eremophila alpestris elwesi* (Blanford).

Observed everywhere except at Diraphūk (N. of Kailās).

Without doubt the most characteristic and abundant bird species on the bare, stony plateau at about 15,000 ft. altitude. In pairs, and breeding plentifully in June. Numerous nests with eggs or young seen, normally c/2 or c/3.

The eggs are brownish pale grey or greyish-stone colour, heavily but finely splashed all over with brown, more densely at the broad end. They measure 24-26 mm. × 17-18 mm. The hatchlings are covered with sparse yellowish-white down.

The nest is a round cup-like depression anywhere on the open featureless plain, neatly lined with soft grass and sheep's wool, measuring about 3 in. across by 1.5 to 1.75 in. deep.

The male has a feeble squeaky song of disjointed strophes, usually uttered from a stone, rather of the volume and quality of some Willow-Warbler's song. Both parents feed the young and attend to the nest sanitation, but what part if any the male takes in incubation I was unable to determine.

The Long-billed Calandra Lark. *Melanocorypha maxima* Blyth.

Observed at Sēkang, Ngāyēzē, Ding Tso, Gyānima Tso—all ca 15,000 ft. Fairly common and abundant on tundra bogs on the edge of lakes and snow-fed streams. Breeding was in progress during June. Birds carrying nest material or constantly chasing one another around were noted at Mānasarōwar. When pursuing a rival the bird flies low with a slow, deliberate flapping of its wings. When alighting after the intruder has been driven off the wings are held motionless in a wide V above the back and the tail spread out exhibiting the white outer feathers prominently. The song, usually uttered from a 'hump' in a bog, is a series of broken or disjointed strophes in which imitations of the calls of other birds e.g. the *tew-tew-tew* of the Redshank and the *tee-tee-tee* of the going-away Green Sandpiper are skilfully interlarded. In the latter case it would be interesting to know where the bird picked up the notes, since the

Green Sandpiper does not occur in these parts.[1] While singing the wings are drooped and excitedly twitched open and closed, the tail partially cocked and the bird turns lightly from side to side. Occasionally a few bars are also sung on the wing.

The nest is a cup-like depression on a water-girt or partially spongy 'hump' in a bog, lined with green grass. The eggs—normally 3—are olive-cream in colour densely blotched with brown almost concealing the ground colour. Two measured 28 × 20 and 28 × 21 mm. One nest (on 27 June) contained 3 chicks about 8 days old partly in down and partly buff-tipped black feathers, with wings and tail in quill. Gape yellow. Inside mouth bright reddish-orange, with 3 black tongue-spots, one at apex and one each on either side of it. Mouth very conspicuous when chicks lying doggo with bill open. Warning pattern?

The Tibetan Skylark. *Alauda gulgula lhamarum* Meinertzh.

Observed at Taklākōt and environs, including Toyo—between 13,000 and 13,500 ft. local. Fairly plentiful in the barley and gram cultivation around villages. Soaring, singing and chasing rivals during June. Frequently a dozen or more up in the air and singing simultaneously. On completion of the song it descends steeply in spirals or in 'falling leaf' style, wings motionless and often held in a wide V above the back in a manner reminiscent of our Red-winged Bush Lark (*Mirafra erythroptera*). Many birds were feeding young in the first week of July.

Ludlow found it common near Taklākōt in Sept. 1932 and obtained a specimen at Rugong.

The Rufous Short-toed Lark. *Calandrella brachydactyla dukhunensis.*

Ludlow obtained specimens at Rākhas Tāl in Sept. 1932, and found it abundant between Rākhas Tāl and Gartok, in flocks.

The Short-toed Lark. *Calandrella acutirostris.*

Observed throughout except about Diraphūk (N or Kailās). The second commonest and most abundant bird species in this part of Tibet. It loves open stony and shingly wastes and was most plentiful, in pairs, on the Barkha Plain where breeding was in full swing during June. Although it nests on the same sort of gravelly flat ground as the Horned Lark, I noted the nests to be as a rule less distant from water than in that species. The adults resort regularly to bogs and the water's edge e.g. at Mānasarōwar, Ding Tso, Gyānima Tso, to collect insects for their young.

Its usual note is a sharp *trri*. The male occasionally soars wanderingly and sings an insipid song consisting for the most part of its own *trri* notes strung out disjointedly. The nest is very similar to that of the Horned Lark but smaller, measuring about 2.5 in. in diameter × 1.25 in. to 1.75 in. deep. Sometimes it is quite unprotected and in the open, at others under a diminutive bush. c/3 is the norm. The eggs are greyish-white faintly stippled or splashed with pale brown somewhat more densely at the broad end where the markings sometimes coalesce to form a distinct ring. Several measured were 22-23 × 15-16 mm. Many birds were feeding young in the first week of July.

Ludlow obtained specimens at Rugong, and found it common everywhere in September 1932.

The Hoopoe. *Upupa epops* subsp.

I did not come across it at all in June-July, but in September Ludlow found it common everywhere from the Lipu Lekh to Darchan, on the Kailās circuit and elsewhere in Western Tibet.

The Swift. *Micropus apus.*

Observed only at Toyo, 13,000 ft., 6-7-45: Several birds hawking about the conglomerate cliffs flanking the Karnāli River.

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[1] Ludlow records it in his notes.

The Horned Owl. *Bubo bubo.*

Observed only near Jiu Gompa ca 15,000 ft. (N. of Mānasarōwar). A solo sleeping in an outscoured hollow in a steep clay bank of the Ganga Chuu near the hot springs, 16-6-45.

The Little Owl. *Athene noctua* subsp.

Ludlow saw a little owlet, 'probably *ludlowi*' at Darchan in September 1932.

The Himalayan Griffon Vulture. *Gyps himalayensis* Hume.

Observed only at Nyandi Gompa ca 16,000 ft., (W. of Kailās) a solo soaring high above the monastery, 19-6-45.

The Lämmergeier or Bearded Vulture. *Gypaëtus barbatus.*

Observed at Taklākōt, Tarchan, Diraphūk.
Uncommon. Occasional solos sailing round contours of cliffs etc.
'Seen between Lipu Lekh and Darchan' F. Ludlow, Sept. 1932.

The Kestrel. *Falco tinnunculus.*

Observed at Ngāyēzē, Gossul Gompa (W. shore of Mānasarōwar), Ding Tso, Gyānima Mandi. Sporadic solos.

The Cherrug Falcon. ? *Falco cherrug.*

Observed at Lējandak, ca 15,000 ft. (S. edge of Barkha Plain). A solo on the wing at long range, 27-6-45. Identity not verified.

Eagle. *Aquila rapax.*

Observed only at Khārkho, ca 15,000 ft., 2-7-45.

A solo in tundra bog by Gyānima Tso, chivvied and chased about by a pair of Brahminy Duck. General colouration blackish. Cere grey. No pale bar in tail.

The Tawny Eagle. *Aquila rapax.*

Observed only near Jiu Gompa ca 15,000 ft (N. shore of Mānasarōwar) 16-6-45. Solo. Identity doubtful.

Pallas's Fishing Eagle. *Haliaëtus leucoryphus* (Pall.).

Observed at Ngāyēzē, Gossul Gompa, Zūnthūlphūk, Ding Tso, Lha Chhu, Gyānima Tso, Rākhas Tāl. Highest 16,000 ft. Quite common and plentiful in the neighbourhood of the lakes. Usually seen singly perched inert on mounds around or in the midst of the adjacent marshes. At the N.E. end of Ding Tso over 20 birds were counted on an area of perhaps as many acres, and 15 on another small tundra bog along the southern edge of Nāl Ugro (the name of the northern section of Barkha Plain which extends eastward to Ding Tso). They all seemed to be well gorged most of the time. Except for a single instance I never saw any of the birds making the least effort to obtain food. On that occasion a bird caught a fish about 12 in. long.

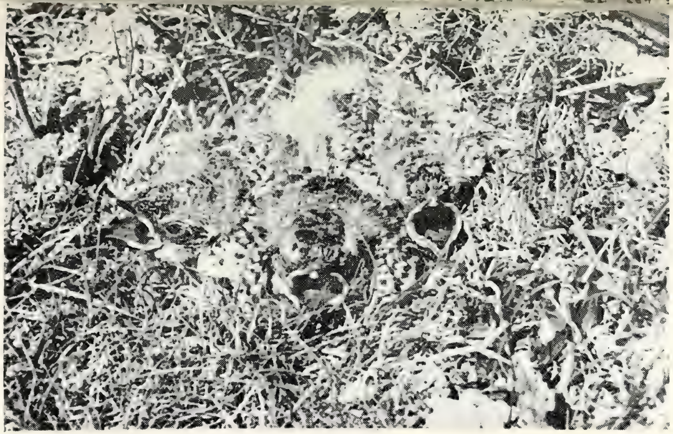
This eagle is doubtless only a summer visitor to these high elevation lakes. There are no trees here for it to nest in, and during winter food must be unobtainable since all the waters become frozen.

Ludlow only saw a single pair on the Ganga Chhu at Jiu on 7th Sept. (1932) which suggests that southward emigration may already have begun.

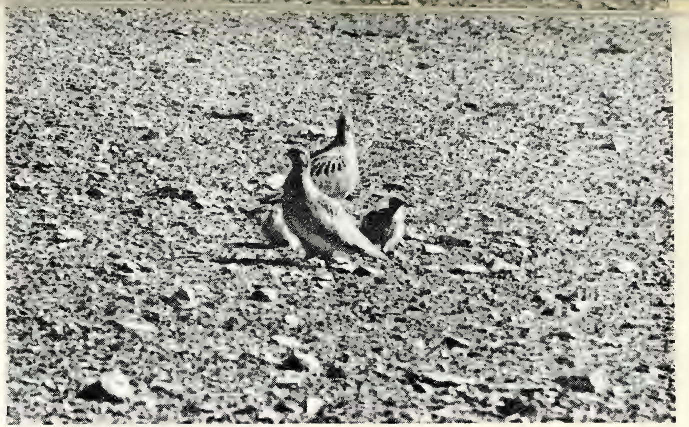
The Buzzard. *Buteo* sp.?

Observed on Barkha Plain below Tarchan, ca 15,000 ft.

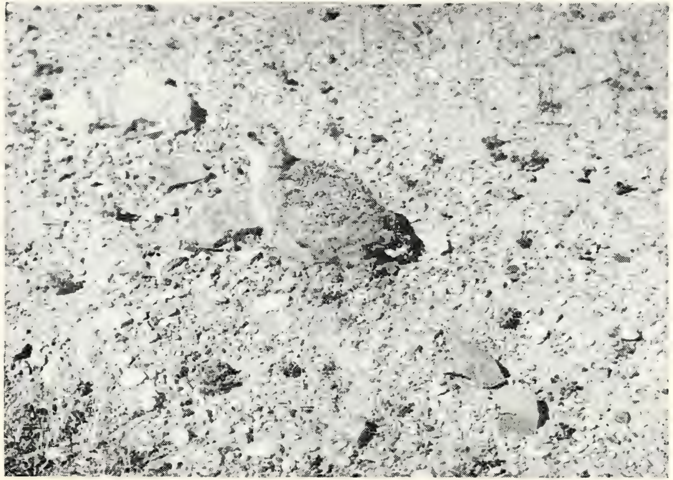
A pair on ground by shepherds' encampment. General colouration chestnut. Head and neck pale—almost buffy cream. Tail buffy cream colour, as also a large round patch near tip of open wings, on the underside.



Nest and chicks of Large Calandra Lark



Tibetan Sandgrouse and chicks



Downy Chick of Tibetan Sandgrouse

Turkestan Rock Pigeons

Copyright *Sálim Ali*

Black-necked Cranes on nesting ground

Nest and Eggs of Redshank

The Turkestan Hill Pigeon. *Columba rupestris turkestanica* Buturlin.

Observed at Taklākōt, Toyo, Ngāyēzē, Gossul Gompa (W. shore of Mānasarōwar), Diraphūk, Dōlma La, Gyānima Mandi, Pāla. Highest 18,600 ft.

Common locally about villages, cultivation and monasteries. Living in colonies on cliffs. Numbers were usually met with at all goat-train halting stations, feeding on the grain dropped out of the pannier packs. Also at the summit of well-used mountain passes where grain is springled in thanksgiving by pious pilgrims. Its call is a high-pitched 'cheeky' quick-repeated *Gūt-gūt-gūt-gūt*, reminiscent of Jerdon's Imperial Pigeon (*Ducula b. cuprea*) of Southern India.

This pigeon, easily distinguished from our familiar Blue Rock (*C. livia*) by its whitish underparts and the broad white bar across its tail, completely replaces *livia* trans-Himalaya.

Ludlow noted it as common at Taklākōt, and between Tarchan and Gartok. Sept. 1932.

The Snow Pigeon. *Columba leuconota.*

Only observed at Pāla ca 14,200 ft. (near Lipu Pass) 8-7-45—a pair.

This species was otherwise completely absent trans-Himalaya. Ludlow did not meet with it in Sept. (1932).

The Tibetan Sandgrouse. *Syrrhaptes tibetanus* Gould.

Observed at Rangūng, Sēkang, Gemoshīsa. Highest ca 15,000 ft.

Not uncommon. In pairs or parties of 6 to 15 on bare gravelly plains and drinking at tundra-girt streams etc. Surprisingly tame, allowing approach within easy catapult range. Call: typical Sandgrouse but deeper and more musical—a pleasant loud *koonk-koonk* etc. in slightly varying keys, reminiscent of the Demoiselle Crane (*Anthropoides virgo*). Usually uttered on the wing. Ludlow found them in flocks of 20-30 and very tame, between Rākhas Tāl and Gartok—Sept. 1932. On 1 July a flock was come upon including a pair with 3 (or 4?) juveniles in mixed down and feather plumage, about the size of Grey Quail. Swift runners. When approached, the parents and young isolated themselves and walked away from the rest of the flock. After submitting to encirclement by 3 people for over 5 minutes for photographs, the female suddenly apprehended danger and commenced doing the 'broken wing' trick, fluttering piteously along the ground for over 20 yards away from the chicks. Upon this the chicks immediately lay doggo and 'froze', becoming completely obliterated from view among the gravel though only a few feet away. They would have been quite easily lost if only one pair of eyes had been watching and that momentarily distracted by the adult's antics.

The Chakor. *Alectoris graeca chukar.*

Ludlow obtained specimens near Taklākōt in the first week of September (1932).

The Snow Cock. *Tetraogallus* sp?

Heard in the Kailās Range near Diraphūk at ca 17,000 ft. (19-6-45) and on the rugged crags above Shēlēkhookar ca 16,000 ft. (4-7-45).

4 birds shot by Ludlow in the Sazi La, farther to the west, in Sept. (1932) are *T. t. tibetanus.*

The Black-necked Crane. *Grus nigricollis* Przewalski.

Observed at Ding Tso, Lejandak Tso, Gyānima Tso (Khārkho)—all ca 15,000 ft. Frequents tundra bogs around the margin of lakes. In pairs during June and early July, and breeding. Pairs prancing and leaping widely and bowing to each other exactly as in the Sarus Crane. Voice and trumpeting calls also very similar to that bird's, only somewhat higher pitched.

A nest consisting of a few reeds spread out, with a single fresh egg, was found on 25 June on a spongy grass-covered hump—floating islet—in the broad belt of bog on the N. edge of Ding Tso lake. The egg is greenish-grey or olive-grey in colour with rough splodges of faint reddish-brown all over, more densely at the broad end. It measures 107×66 mm. Its contents, equal to about 6 fowl's eggs, were delicious scrambled and provided a welcome change from the eternal dal and rice!

The Brown-headed Gull. *Larus brunnicephalus* Jerdon.

Observed at Ngāyēzē, Tseti Tso (W. shore of Mānasarōwar), Ganga Chhu (near Jiu Gompa), Barkha, Ding Tso, Lha Chhu, Gyānima Tso (Khārko)—all between 15,000 and 15,300 ft.

Fairly common and in full brown-headed summer plumage. About 50 pairs nesting in an inaccessible part of bog along the eastern shore of Ding Tso Lake, 25-6-45. Each nest was a separate raised mound of grass etc. above water level and a few feet away from its neighbour. Now mostly with eggs. Several pairs were also nesting in a similar marsh about Gyānima Tso, 2 July.

On Tseti Tso I noted a single example of a smaller gull without brown head which looked exceedingly like the Black-headed (*L. ridibundus*) and had the colour pattern of that species in the wing.

Seen on Rākhas Tāl in Sept. (1932) by Ludlow.

The Tibetan Tern. *Sterna hirundo tibetana* Saunders.

Observed at Rangūng, Ngāyēzē, Tseti Tso, Barkha, Ding Tso, Gyānima Tso (Khārko), Taklākōt.

In small numbers at all waters and marshes on the plateau, beating up and down and occasionally plunging in for food. Pairs chivvying Black-necked Cranes and a man approaching a particular islet in Ding Tso, 25-6-45. Undoubtedly breeding, but no nest discovered. Its call is a harsh *kreeak* or *SEAC* very like the croak of the Tibetan Raven.

Mānasarōwar and Rākhas Tāl in Sept.! F. Ludlow.

The Oystercatcher. *Haematopus ostralegus.*

'I saw, to my surprise, an Oystercatcher at Rugong on 6 September' (1932) F. Ludlow.

The Pamirs Lesser Sand-Plover. *Charadrius mongolus* (*atrifrons* Wagler).

Observed at Sēkang, Ngāyēzē, Tseti Tso, Ganga Chhu (near Jiu Gompa), Barkha, Pēlūng Yōma, Ding Tso, Gyānima Tso (Khārkho and Chhakra), Shēlēkhookar—all between 14,500 and 15,500 ft. Common. Pairs on and about tundra bogs everywhere. Now in handsome breeding plumage with rust coloured breast, hind head and upper neck—very different from the prosaic sandy brown garb in which we see it on the western seaboard in winter. Territorial rivalry and pre-nuptial chasing in progress. In this the birds fly close above the ground on rapidly vibrating wings, uttering a peculiar hard *Tk-tatrr-tatrrwhee*. Sometimes the 'war cry' is *Tit-tit-trr-trrweet* of the same quality as the call of the Indian Nightjar (*Caprimulgus asiaticus*).

Several nests with c/3 found in June on dry stony ground beyond the fringe of marshes. The nest is merely an unlined scrape. Eggs pale green to dark biscuit colour or khaki, stippled fairly evenly all over with reddish-brown (dry blood colour). The 'broken wing' trick appears to be very popular with this species.

Observed on the southern shores of Rākhas Tāl, 6 Sept. (1932) by Ludlow.

The Curlew. *Numenius arquata* subsp.

'Seen near Rugong on 6 September' (1932) F. Ludlow.

The Green Sandpiper. *Tringa ochropus.*

Jiu, 7 Sept. 1932! F. Ludlow.

The Redshank. *Tringa totanus.*

Observed at Ding Tso, Gyānima Tso (Khārkho)—ca 15,000 ft.

15 to 20 pairs on the former and at least 2 pairs on the latter, all evidently breeding on the tundra bog along the margins of the lakes. A nest (25 June) was a deepish scrape lined with grass on a flat grassy islet in Ding Tso, and

contained c/4. The eggs were drab-coloured with purplish-brown markings. They were surprisingly large for the size of the bird, being bigger than those of the Red-wattled Lapwing.

Temminck's Stint. *Erolia temminckii.*

Ludlow obtained a specimen at Rugong, 5 September (1932).

The Bar-headed Goose. *Anser indicus* Latham.

Observed at Taklākōt, Ngāyēzē, Tseti Tso, Ding Tso, Lha Chhu, Gyānima Tso (Khārkho)—13 to 15,000 ft.

Common, in fair numbers, at all lakes, large and small, frequenting the pools and shallows in and about the tundra bogs around their margins. Nesting was general in June, and several pairs leading downy goslings. Breeding evidently commences early as by 30 June many full-fledged young of the year were already about in family parties. The nests are pads of down and feathers individually or several together a few yards apart, in a depression on the spongy semi-floating 'humps', usually in an inaccessible part of a marsh. The normal clutch was of 3 to 5, the eggs being ivory white in colour and thick-shelled. Two measured 81×57, 87×57 mm.

The Bar-head was reported by the locals to breed regularly in very large numbers on the islets known as Lachato and Topserma in the S. and W. of Rākhas Tāl, but without a boat it was impossible for me to visit these places. In contrast to their well-known wariness in their winter quarters, the birds were amazingly tame and confiding here. At Tseti Tso 10 to 15 pairs with perhaps as many Brahminy Ducks grazed unconcernedly on the grassy margin of the lake at sunset within 50 yards of our tents! The local Tibetans have a legend that the geese, having gorged themselves on rice during the winter months in the plains, have lost their voice (some say even sight) when they first arrive here in spring. Only after eating the salt in the vicinity of the sacred lake do they regain these senses and resume their normal '*aang-aang*' calls. They say that the birds come flying in so thickly wing to wing, that if one of their number is shot dead he is borne along on the wings of his companions. The fatality is only discovered when the birds are alighting on Mānasarōwar!

Rākhas Tāl, Jiu and Barkha! Sept. 1932. F. Ludlow.

The Gadwall. *Anas acuta* Linn.

The Pintail. *Anas strepera* Linn.

Observed only at Ngāyēzē, 13-6-45. Several among a mixed flock of about 50 duck keeping to a lagoon and mudspit on the S.W. shore of Mānasarōwar. Apparently not interested in breeding here.

The Brahminy Duck. *Casarca ferruginea* (Vroeg).

Observed at Sēkang, Ngāyēzē, Tseti Tso, Ganga Chhu (near Jiu Gompa), Lha Chhu (near Dirapūkh and on Barkha Plain), Ding Tso, Lejandak Tso and 'lūmbo' (stream valley), Gemoshīsa, Gyānima Tso (Khārkho), Shēlēkhookar—15-17,000 ft.

Common at all lakes. Also in flat boggy stream valleys flanked by high cliffs. Breeding in full swing during June, and many pairs leading downy young. Many breeding high up in holes in precipitous crags, in one case at least 1,500 ft. above the level of the marshy valley bottom. How the fluffy hatchlings would be brought down to the water from this great height remained an intriguing question. It was a curious sight to see these ducks flying along the rugged contours and alighting on rock pinnacles high up on the mountainside—behaving in fact very like rock-pigeons.

On a shingle bank by Mānasarowār lake a party were observed in some sort of communal (prenuptial?) ceremonies on 13-6-45. Individuals seemed to be chasing individuals on the ground, and pairs pairs. The aggressive attitude was very vulture-like: neck craned forward stiffly bill to ground, wings drooped at sides, and tail spread open and depressed almost scraping the ground. These antics were accompanied by angry notes. They had obviously something to do with pair formation and approximated to the 'Incitement Displays' described by Heinroth (Die Vögel mitteleuropas, Vol. III p. 183)

In September (1932) Ludlow found it common everywhere.

The Goosander. *Mergus merganser* (*orientalis* Gould).

Observed at Ngāyēzē, Lha Chhu (at Nyandi W. of Mt. Kailās, and on Barkha Plain), Zūnthūlpūkh. Occasional solos or pairs on lakes and streams. No sign of breeding activity.

The Great Crested Grebe. *Podiceps cristatus.*

Observed at Ngāyēzē (Mānasarowar), Ding Tso, Gyānima Tso (Khārkho).

Quite common. Nesting plentifully in June. Eggs. On a lagoon (S.W. shore of Mānasarōwar) counted 8 nests with birds brooding in an area of less than 10 acres; 40 to 50 nests in another smaller area on the E. shore of Ding Tso adjoining the breeding colony of Brown-headed Gulls. The nest is a collection of grass etc. on a floating or anchored mound of rubbish and weeds. In almost every case the sitting bird covered up the eggs with nest material before swimming away on my approach.

BIRDS NOTED IN THE MAHASU-NARKANDA-BAGHI AREA OF THE SIMLA HILLS.

BY

N. F. FROME, C.I.E., D.F.C., M.SC., M.B.O.U.

A trek to Narkanda and Baghi, the latter some 50 miles further into the hills north-east of Simla, is nowadays quite popular with visitors to the Simla hills. Having had the opportunity during two successive years of making this enjoyable trip during the first fortnight of June, when on each journey detailed records of the birds seen were kept, an account of the species noted may be some value to others who visit Narkanda and Baghi just before the rains.

The list given hereafter (which is by no means comprehensive but contains, it is believed, most of the commoner birds to be seen) refers only to the area from Mahasu (8,300 feet) six miles from Simla, to Narkanda (9,100 feet) on the main Hindustan-Tibet road and along the mule track to Baghi (8,850 feet) and Kadrala (8,900 feet) 10 and 17 miles, respectively, further east of Narkunda. From Mahasu the first stage of 6 miles to Fagu (8,200 feet) is mostly in forest; the second stage of 5 miles to Theog (7,400 feet) traverses open scree covered hillsides and cultivated tracts; coniferous forest, steep hillsides and cultivation occur on the next 11 miles to Mattiana (7,700 feet). At Mattiana which is at the head of a long valley leading to the Giri watershed more 'foothills' species seem to occur than elsewhere on the route. The 11-mile stage from Mattiana to Narkanda contains cliffs, ravines and stretches of denser forest. Between Narkanda and Baghi both the main Hindustan-Tibet road, continuing to Rampur in the Sutlej valley, and the branch path to Baghi skirt Mount Hathu through heavy pine and spruce forest with immense trees and precipitous hillsides. From Baghi to Kadrala forest alternates with open hillsides and rocky ravines. As would be expected, therefore, a variety of tree and forest haunting birds as well as those which favour more open and cultivated hill country may be seen. Of interest is the extent to which nominally 'plains' species such as the House Sparrow, Common Mynah and Common Pariah Kite have penetrated the Simla Hills.

An indication of the commonness of the various species in late May and early June in accordance with the frequency with which observed in the two successive years is included in the notes. Incidentally, throughout the area it was found that the best time to see and hear birds is as elsewhere, from just before sunrise until about 11.0 a.m. and after that time late in the evening.

Corvus macrorhynchos. The Jungle Crow.

Common throughout the whole area in all types of country. Seen up to 10,000 feet. Even in secluded forest tracts, one or two of these birds soon appear to investigate the intruder's food producing possibilities!

Urocissa melanocephala. The Red-billed Blue Magpie.

Fairly common en route and common in the Narkanda and Baghi area where its '*kik-kik-kik kuk-kuk-kuk*' call is frequently heard as well as a variety of other metallic alarm notes and calls.

Urocissa flavirostris. The Yellow-billed Blue Magpie.

Uncommon—seen only on two occasions in the Mahasu-Kufri ridge forest.

Garrulus lanceolatus. The Black-throated Jay.

Not common—seen once near Mattiana.

Garrulus bispecularis. The Himalayan Jay.

Grating calls are fairly often heard, but this bird needs to be looked for, when it may be seen in the forests up to Baghi usually slipping from bough to bough of a tree close to the trunk.

Nucifraga caryocatactes. The Himalayan Nutcracker.

Occasionally heard and seen en route; its noisy harsh calls and mewing cries commenting on every happening within its ken are especially evident in the Narkanda, Baghi and Kadrala forests where it is very common.

Parus monticolus. The Green-backed Tit.

Fairly common and occurs at Narkanda, Baghi and Kadrala. Call;—'*teacher*'—frequently heard.

Lophophanes melanolophus. The Crested Black Tit.

Common in forests everywhere—in early June usually to be seen collecting food for young.

Lophophanes rufonuchalis. The Simla Black Tit.

Fairly common in the Baghi forests—a larger and darker edition of the Crested Black Tit.

Lophophanes dichrous. The Brown Crested Tit.

Noted only in the Narkanda-Baghi forest and at Kadrala. It appears to be uncommon.

Aegithaliscus concinnus. The Red-headed Tit.

Not particularly common but noted at Mahasu, Theog, Mattiana and Baghi in the usual cheeping little parties.

Sitta himalayensis. The White-tailed Nuthatch.

Fairly common in the forest around Mahasu—not observed elsewhere.

Garrulax albogularis. The White-throated Laughing Thrush.

Not very common. Seen on Charabra hill near Mahasu.

Trochalopteron erythrocephalum. The Red-headed Laughing Thrush.

Noted only on the Mahasu-Kufri ridge. A confirmed skulker.

Trochalopteron variegatum. The Variegated Laughing Thrush.

Common especially around Mahasu, Narkanda and Baghi. This bird also has the habit of ascending trees from bough to bough making itself evident with its loud whistle '*pitt-we-whee-eer*'.

Trochalopteron lineatum. The Streaked Laughing Thrush.

Common. Occurs in low scrub jungle throughout the whole area—seen up to 9,500 feet. Whistles '*pit-weer*' as well as having other squeaking and murmuring notes.

Grammatoptila striata. The Striated Laughing Thrush.

Uncommon. A small party seen only on two occasions on the Mahasu-Kufri ridge. Harsh alarm note '*oick oick oick oick . . .*' and a whistling call which may be expressed '*oh see saw oh whitey—oh white*'.

Leioptila capistrata. The Black-headed Sibia.

Fairly common in forest everywhere where its loud ringing whistle '*ti-ree-ree ti-ree-ree-ree*' is frequently heard. Occurs at Baghi.

Pteruthius erythropterus. The Red-winged Shrike Babbler.

Uncommon. Seen on one or two occasions only in the Mahasu area.

Molpastes leucogenys. The White-cheeked Bulbul.

Fairly common—seen at Fagu, Theog, Mattiana, Narkanda and Baghi but not in the abundance of the Simla foothills.

Certhia himalayana. The Himalayan Tree-Creeper.

Common in forests up to 10,000 feet. Usually brings itself to notice by its thin piping note.

Luscinia brunnea. The Indian Blue Chat.

Noted at Mahasu and frequently seen and heard in undergrowth in the Baghi forests. Precedes its song of a varying number of loud notes with three or four high pitched squeaky whistles.

Saxicola torquata. The Indian Stonechat.

Common on the open hillsides from Fagu to Narkanda, usually perched on top of a bush or stone.

Rhodophila ferrea. The Dark Grey Bush-Chat.

Common throughout the whole area around cultivation and scrub—the male may often be heard singing his soft little song.

Enicurus maculatus. The Western Spotted Forktail.

A pair of these graceful birds were seen on a stream near the Mattiana dak bungalow.

Turdus albocincta. The White-collared Blackbird.

Fairly common in the Narkanda-Baghi forests. Shy.

Turdus boulboul. The Grey-winged Blackbird.

Common around Mahasu but not observed elsewhere en route.

Arceuthornis viscivorus. The Himalayan Missel Thrush.

Fairly common in pairs in the Mahasu area, the Narkanda-Rampur road forest and around Baghi—usually seen on the ground when undisturbed. A fine songster. Is notably common at Kadrala.

Monticola rufiventris. The Chestnut-bellied Rock-Thrush.

Common in pairs around Mahasu and seen near Theog—the harsh scolding note and 'piping' of these birds attract attention.

Monticola cinclorhyncha. The Blue-headed Rock-Thrush.

Not very common—noted only at Baghi where it was seen and heard singing from the tree tops in the early morning and late evening.

Myophonus caeruleus. The Himalayan Whistling Thrush.

Seen and heard occasionally in nullahs containing streams—particularly around Mattiana and Baghi.

Hemichelidon sibirica. The Sooty Flycatcher.

Noted on a number of occasions around Mahasu and in the Baghi and Kadrala forests—especially on the road to Kadrala. Usually seen 'flycatching' from a fixed tree perch.

Muscicapula superciliaris. The White-eyebrowed Blue Flycatcher.

Common in woods and forests throughout the whole area where its soft trilling call note can frequently be heard. Is usually seen collecting food for young in June.

Eumyias thalassina. The Verditer Flycatcher.

Common at Mahasu but not so common elsewhere—seen near Mattiana and Theog.

Lanius schach. The Rufous-backed Shrike.

Not common. Seen on one occasion near Mattiana dak bungalow.

Pericrocotus brevirostris. The Short-billed Minivet.

Fairly common throughout the whole area. Usually seen in small parties or pairs in the tree tops, the scarlet of the males being very conspicuous.

Dicrurus macrocercus. The Black Drongo.

Not very common—seen at Mahasu, Theog and Baghi.

Dicrurus longicaudatus. The Indian Grey Drongo.

Noted only at Mahasu, Mattiana and Baghi.

Phylloscopus trochiloides. The Greenish Willow-Warbler.

A very doubtful identification—but two or three pairs which seemed to be of this species were observed near the Mattiana dak bungalow.

Phylloscopus magnirostris. The Large billed Willow-Warbler.

Noted in the wooded ravines on the side of Mount Hathu. Call note: a high pitched whistle;—'*eeeee, eee-eee, eee-eee.*'

Phylloscopus occipitalis. The Large Crowned Willow-Warbler.

Abundant everywhere where there are trees, up to 10,000 feet, and probably higher—its whirring song being a conspicuous feature of the Simla hills in June.

Horornis pallidus. The Pale Bush-warbler.

This amusing little bird is common around Narkanda and Baghi. It spends its time creeping about the interior of thick bushes and is difficult to see but its constantly uttered thin whistle '*eu-eu-eu-eu-eu-eu*' followed by a loud and vehement '*I see you see?*' or '*I see you!*' cannot be mistaken.

Acridotheres tristis. The Common Mynah.

Has found its way into the hills as far as Mattiana where it is particularly common in and around the village but was not seen beyond that place.

Perissospiza icteroides. The Black & Yellow Grosbeak.

Common—especially so in the Mahasu, Narkanda, Baghi and Kadrala forests where its quick whistle '*keeky-too, keeky-too*' can constantly be heard. Often seen feeding on the ground.

Pyhrrhula erythrocephala The Red-headed Bullfinch.

A pair of these handsome finches were seen once in a wooded nullah on the Baghi-Kadrala road.

Hypacanthis spinoides. The Himalayan Greenfinch.

Noted only in fairly open country at Mahasu, Mattiana, Baghi and Kadrala where it was occasionally observed.

Passer domesticus. The House Sparrow.

Like the Common Mynah the House Sparrow is common in the villages as far as Mattiana, where it is annoyingly evident nesting in the dak bungalow, but does not yet seem to have found its way further into the hills.

Passer rutilans. The Cinnamon Sparrow.

Not very common—seen only at Fagu, Baghi and Mattiana in the vicinity of the villages.

Emberiza cia. The Eastern Meadow Bunting.

Common throughout the area, favouring the more open country, constantly uttering its cricket-like '*cheep*' and occasionally singing a twittering little song.

Hirundo daurica. The Red-rumped Swallow.

Frequently observed en route up to Narkanda and at Kadrala but not seen at Baghi. Often rests on the ground.

Oreocorys sylvanus. The Upland Pipit.

Noted on the scree covered hillsides near Mattiana and between Fagu and Theog—has a loud creaking note '*put — eeeeeee*' and '*eeeeeee — put*'.

Zosterops palebrosa. The White-eye.

Noted only on one occasion at Mahasu.

Aethopyga gouldiae. Mrs. Gould's Sunbird.

This beautiful bird was seen occasionally in the Mahasu area feeding on flowering trees. Its call of '*Tzit tzit — tzit tzit — ———*' draws attention to its presence.

Picus squamatus. The Scaly-bellied Green Woodpecker.

Not often seen. Noted around Mahasu and in the Baghi forests.

Hypopicus hyperythrus. The Rufous-bellied Woodpecker.

This handsome little woodpecker is to be seen fairly frequently in the forest near Narkanda on the Rampur road. Observed drumming on a hollow tree trunk.

Dryobates himalayensis. The Himalayan Pied Woodpecker.

Fairly common in the Mahasu area and in the Narkanda-Baghi and Kadrala forests.

Megalaema virens. The Great Himalayan Barbet.

The mournful cry of this species; '*pee — oh*' — can be heard in all the valleys en route up to Kadrala.

Cuculus canorus. The Asiatic Cuckoo.

The familiar '*Cuck-oo*' call of this bird is heard everywhere and it is particularly common at Mattiana, Narkanda, Baghi and Kadrala. At these places also a loud, obviously cuckoo, call (somewhat reminiscent of the notes of the White-cheeked Bulbul) which may be expressed '*Quick, quick, drinking with you*' is also very frequently heard. This was traced to a Cuckoo of the *canorus* type but whether *canorus*, *optatus*, or *poliocephalus* it was not possible to determine without procuring a specimen.

Cuculus optatus. The Himalayan Cuckoo.

Common—particularly so at Mahasu, Narkanda, Baghi and Kadrala. Its call *hoop hoop hoop hoop* is frequently evident at dawn, long after sunset and during moonlit nights.

Cuculus micropterus. The Indian Cuckoo.

Fairly common throughout the area and easily recognised by its call of *Make more pekoe.* Often calls before sunrise.

Hierococcyx sparveroides. The large Hawk-Cuckoo.

Heard at Mahasu, Narkanda, Baghi and Kadrala where it is common. Has the same ascending trill and call *Brain fever* as the Common Hawk-Cuckoo but less shrill. Also calls before sunrise and on moonlit nights.

Cacomantis merulinus. The Indian Plaintive Cuckoo.

Heard only on one occasion in the Mashobra Valley below Mahasu. Call: *how few, how few.*

Upupa epops. The Hoopoe.

Noted only at Fagu and Narkunda.

Micropus pacificus. Blyth's White-rumped Swift.

A flock of swifts identified as Blyth's Swift by the white rump and larger size than the House Swift were observed in flight below Mahasu before a storm. It is believed the Alpine Swift with its white underparts was also seen in the same locality.

Collocalia fuciphaga. The Himalayan Swiftlet.

Small flocks may occasionally be seen circling over the valleys usually preceding a storm.

Strix nivicola. The Himalayan Wood Owl.

Noted at Baghi. Call: *Hu-hoo* and *Huhu-hoo.*

Otus spilocephalus. The Himalayan Scops Owl.

The double whistle *phew.....phew* of this bird can be heard at night in the forests particularly at Mahasu and Narkanda.

Sarcogyps calvus. The King Vulture.

Not common—seen only on two occasions, once at Mahasu and once at Narkunda.

Gyps himalayensis. The Himalayan Griffon.

Common everywhere in the area.

Pseudogyps bengalensis. The White-backed Vulture.

Uncommon—seen once in flight over the Theog ridge.

Neophron percnopterus. The Neophron.

Fairly common throughout the whole area up to Baghi.

Gypaëtus barbatus. The Lämmergeier.

Fairly common everywhere—usually seen 'contouring' the hills with outstretched wings occasionally flexing, bearded head turning from side to side as every ravine and spur is examined.

Falco peregrinus. The Shahin Falcon.

A falcon in flight over the Mashobra valley below Mahasu and of which a close view was obtained was noted as a Shahin but the identification was not certain.

Falco tinnunculus. The Kestrel.

Fairly common—especially so around the steep hillsides near Narkanda and Baghi.

Ictinaëtus malayensis. The Black Eagle.

This fine bird was seen once,—skirting the edges of cliff forest and threading the trees on the side of Mount Hathu. Dark colour, fan tail and markedly upturned flight feathers are notable.

Haematornis cheela. The Crested Serpent-Eagle.

Seen on two or three occasions coasting with swept-back wings over the Mahasu—Kufri ridge uttering its loud whistling call.

Milvus migrans. The Common Pariah Kite.

Although common at Simla and at Mahasu the Common Kite does not seem to have moved further into the hills,—not even to Fagu—it was however observed once in flight crossing the saddle near Narkanda village.

Sphenocercus sphenurus. The Kokla Green Pigeon.

Noted in a deep forested ravine on the side of Mount Huttoo. The human-like whistle of this bird described by Whistler as *Why, we wat cheer; what are we waiting for?* immediately attracts attention.

Columba livia. The Blue Rock Pigeon.

Not common but a number seen at Mattiana and a pair at Baghi.

Streptopelia orientalis. The Rufous Turtle Dove.

Common—particularly so around Narkunda, Baghi and Kadrala. The speed at which this bird flies through the interstices of thick forest is rather astonishing.

Streptopelia risoria. The Indian Ring Dove.

Not common. Noted only at Mattiana where only one individual was seen.

Pucrasia macrolopha. The Koklas Pheasant.

Seen and heard in the Catchment Area forest near Mahasu.

Gennaeus hamiltoni. The White-crested Kalij Pheasant.

Occurs fairly commonly in the Mahasu area but not noted elsewhere en route. Pheasants were heard (but unfortunately not seen!) in the Narkunda-Hathu Baghi area but lack of familarity with their calls precluded identification. Mr. A. E. Jones, however, states that the Monal and the Western Horned Pheasant occur on Hathu.

Arborophila torqueola. The Common Hill Partridge.

The low toned melancholy call *poo-or* of this bird is evident in the forests around Mahasu, Narkanda and Baghi.

Alectoris graeca. The Chukor.

Seen on rocky hillside between Mattiana and Theog and heard near Baghi and Kadrala. Probably also occurs on the Theog scree slopes.

Francolinus francolinus. The Black Partridge.

Noted in the valleys below Mahasu, Fagu, Theog, Mattiana and Narkanda. The grating call may be represented in the Morse code as 'TNK', i.e., '— — — —.' and is especially evident in rainy weather.

It may perhaps be emphasized that the foregoing record applies only to the period from the middle of May to the middle of June. The avifauna of any particular area in the hills is subject to considerable change—with seasons, of course, and with breeding periods, rainfall, food supply etc. The species observed in the area under discussion in October, for instance, will contain birds from the higher Himalayas and omit summer visitors (vide 'Some Birds Observed at Fagoo near Simla', H. Whistler, *J.B.N.H.S.*, October 20th 1919); species which are confined to a particular area whilst breeding will wander away therefrom before and after that period; a prolonged dry spell seems to be accompanied by a desertion of the hill tops and a descent to the valleys. Similarly, the ripening of crops and the flowering and fruiting of trees and bushes produce local movements. At any time of the year, however, a study of the birds of the Simla Hills is a most interesting subject.

ADDENDA

As a result of a further visit to Mahasu and Narkanda during late May and early June this year (1946) some species were observed additional to those listed in the foregoing note. Further data are also available from Waite's paper on 'Birds on the Hindustan-Tibet Road, N-W. Himalaya' *J.B.N.H.S.* Vol. 45 part 4, page 531 so far as his account refers to the Mahasu-Narkunda-Baghi area and for the months of May and June. This information is given below with an indication of still other species which may be met with, although not at all common.

(1) ADDITIONAL SPECIES NOTED IN MAY/JUNE 1946:—

Stachyridopsis pyrrhops. The Red Billed Babbler.

Not common. Heard in the Catchment area below Mahasu in May. Call, a clear evenly pitched whistle of 5 to 9 notes.

Microscelis psaroides. The Black Bulbul.

Small flocks seen in the tree tops on three or four occasions near Narkunda in early June.

Culicipapaceylonensis. The Grey Headed Flycatcher.

Uncommon. Seen in the Mahasu area at the end of May.

Seicerous burkii. The Black Browed Flycatcher Warbler.

Not common. Seen near Mahasu at the end of May in hillside forest scrub. This bird is a spring passage migrant.

Glaucidium brodiei. The Collared Pigmy Owlet.

Not previously noted but frequently seen and heard this year in the forests near Mahasu. Call, an oft-repeated four note whistle,—'*poot putput poot*', which carries a long way and is evident during the day as well as at dawn and dusk. (Waite states met with at Baghi in June.)

Clamator jacobinus. The Pied Crested Cuckoo.

Not at all common. Heard in the Mahasu area at the end of May. (Seen by Waite at Mattiana in June.)

The following species were seen this year in the Narkunda area in addition to the places previously noted :—

White Throated Laughing Thrush
Indian Blue Chat
Himalayan Greenfinch
Scaly-bellied Green Woodpecker.

(2) ADDITIONAL SPECIES FROM WAITE'S PAPER :—

Sitta leucopsis leocopsis. The White-cheeked Nuthatch.

Specimen obtained between Baghi and Sungri in June.

Siva strigula strigula. The Stripe-throated Siva.

Male obtained at Baghi in June.

Oreocincla dauma dauma. The Small-billed Mountain Thrush.

Specimen obtained on Mount Huttoo on 24th June.

Emberizafucata arcuata. The Indian Grey-headed Bunting.

Few seen between Narkunda and Mattiana in June.

Emberizastewarti The White-capped Bunting.

Seen at Baghi in June.

Cuculus poliocephalus poliocephalus. The Small Cuckoo.

Obtained in June at Baghi.

(3) ADDITIONAL SPECIES WHICH MAY BE MET WITH IN MAY & JUNE :—

The Green Shrike-Babbler.
The Fire-cap.
The Brown Hill Warbler.
Pallas' Willow-Warbler.
The Orange-gorgetted Flycatcher.
The Slaty Blue Flycatcher.
The Blue Rock-thrush.
The Brown Bullfinch.
The Himalayan Goldfinch.
The Black-naped Green Woodpecker.
The Brown-fronted Pied Woodpecker.
The Golden Eagle.
Bonelli's Eagle.
The Booted Eagle.
The Sparrow-hawk.
The Hobby Falcon.
The Monal Pheasant.
The Horned Pheasant.
The Woodcock.

The author's thanks are due to Mr. A. E. Jones who very kindly checked the list in paragraph (3).

BREEDING AND DEVELOPMENT OF INDIAN* FRESH-WATER AND BRACKISH-WATER FISHES.

BY

S. JONES, M.SC.

Part I.

INTRODUCTION.

In the course of a study of the breeding and developmental histories of some Indian fresh-water and brackish-water fishes, the literature on the subject was found by the author to be not only scanty but so scattered that he felt there was a real need to bring together in the form of a paper all the available information on the subject. It was just as he embarked on this work that the Editors of this *Journal* invited him to write a general article of this type in order to arouse interest on the subject among the members of the Society. This work is primarily intended for field naturalists rather than for specialists though the latter also may find it helpful.

Breeding and developmental studies of fishes are full of interest, and from the author's experience of the last few years, offer plenty of scope to anyone willing to devote some attention to them. These studies consist mainly of fieldwork and do not therefore require costly equipment and laboratories. Observations under aquarium conditions, though artificial, are still valuable, and interesting data can be obtained which can be checked later under natural conditions.

At a time when we hear from every quarter of the country the cry for the improvement of the fisheries so as to effect a greater production of fish and thereby to ensure a richer supply of food to the people, the importance of research on the life-histories, rate of growth, food, migrations, etc. of fishes cannot be over-emphasized. The information we have on the biology of Indian fishes is in no way comparable to the extensive knowledge accumulated as a result of years of well planned and systematically conducted research on the important fishes of the western countries. The little we know of a few fishes of this subcontinent is mostly from isolated observations and a great deal of further work is required before any practical use could be made of the knowledge. Though the following remark made by Dr. Stanley Kemp in 1938 in the course of an address at Cambridge to the Zoological Section (D) of the British Association does not exactly hold good at the present day, it helps to throw some light on the meagreness of our knowledge until quite recently. 'It is no great exaggeration to say that in Africa and almost throughout the stretch of the Indo-Pacific region there is scarcely a fish whose life history is fully known and whose various stages from egg to adult can be recognized. Of such matters as age, rate of growth, spawning periods, food and migrations we are equally ignorant; nothing is known of the incidence of fluctuations and nothing in seasonal and other changes in the environment.'

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* Including Burma and Ceylon.

In the case of each fish dealt with in this paper only brief notes on the work done so far are given and for detailed information the reader is recommended the original works. Though no pains have been spared to incorporate in this paper every available reference, any omission may be kindly brought to notice through the columns of this *Journal*. The account is confined to fishes that are known to live and breed or undergo larval development in fresh and brackish water including such essentially marine (anadromous) forms as frequent estuaries and ascend rivers for breeding purposes.

Historical Resumé.

The literature on the subject of breeding and development of Indian fishes is hardly a century old and it belongs to two important periods. The first period consists mainly of the observations of the civil and military officers of the East India Company and the Government of India in the last century. This commences with Jerdon (1848) and is succeeded by Day (1873 & 1878) and Thomas (1870 & 1897). It can be considered a dormant period and the few incomplete notes we get are casual observations confined to breeding habits of some of the common forms with hardly any record on development. It is evident from these works that even in those days the study of the breeding habits of fishes with a view to improving the inland fisheries was engaging the attention of the Government.

The second period which is much more productive than the first begins with Willey (1908, 1910 & 1911) 'whose observations' as Raj (1916, p. 249) remarks 'on the breeding habits of *Ophicephalus striatus* and account of the nest, eggs and fry of some other species in his report on the inland fisheries of Ceylon are substantial contributions to our knowledge of the spawning habits of Indian fresh water fish'. About this time we get the notes by Jenkins (1910) and this is followed by the account of Raj in 1916 on the fresh water fish of Madras. The latter work is an important one as it is rich with his own observations on the breeding habits and development of a number of Madras forms and it has been brought up-to-date by the incorporation of all the previous facts known on the breeding and development of Indian fresh water fishes. His work on Hilsa in 1917 also deserves mention here. The faunistic investigations of the Zoological Survey of India in the Chilka Lake resulted in the work of Bhattacharya in 1917 on the eggs and early stages of three fishes there. Annandale has given in 1918 some notes on the breeding of fishes in the Inlé Lake, Burma, and Southwell and Prashad (1919) notes on certain stages in the development of a Notopterid. A very important work is that of Panikkar in 1920 supplemented by a note in

1924. In the former he has given detailed observations on the breeding season, nesting habits, parental care and early development of two South Indian Cichlids. We know through this work the time of attainment of sexual maturity of the two species—a thing we are practically ignorant of for many other Indian fresh water fish. Khan (1924 & 1926) has given notes on the breeding habits and development of some Punjab fishes and in 1928 of that of the Gold fish. The notes on the collections of gravid females and young larvae of a number of fishes from different localities in Ceylon by Deraniyagala (1929, 1930 & 1930-32) are very useful. The work of Aiyer (1935) on *Acentrogobius neilli* is remarkable in that it is the first account of a detailed nature on the development of any Indian fish though only the embryonic and the early larval stages are given, Jones in 1937 described the breeding and early development of seven Madras fishes and in 1938 of two Ceylon carps. In a paper by Job and Jones in 1938 the breeding and early development of two Synentognathi from Madras are dealt with. The recent work of Hora (1938) on *Hilsa* deserves particular mention here. There is a valuable paper on trout culture in Ceylon by Philip Fowke in 1938. Among the contributions of the last four years those of Kulkarni (1940 & 1943), of Chidambaram (1941), of Nair (1940), of Khan (1943), of Job (1940 & 1941), of Jones and Job (1940) and of Jones (1940, 1940a, 1941 and 1944) are the most important.[1]

We have abstracts of a number of papers (Raj 1917, Rao 1919, Rao 1934, Ahmed 1934 and 1936, Raj 1940 and Mukerjee 1943) from which very little useful information could be gathered due to their condensed nature. The original papers if published would have been very useful.

General Notes on Breeding.

Notes on the breeding of Indian fishes have been given by several workers; but those given by Day and by Thomas during the later half of the last century still remain as some of the most outstanding contributions on the subject. Most of the forms dealt with are from South India.

The report on pisciculture in South Canara by Thomas (1870) is a very useful contribution and his observations hold good for the West Coast fishes in general as the whole region is similar in physical and climatic conditions. He says that the great majority of the small fish spawn in May, June and July (a few of them repeating the performance in October, November, December and January), and the spawning time of the mass of the big fish extends over September, October, November, December and January, but is chiefly confined to December and January.'

Day (1873 & 1877), while dealing with the breeding of fishes in freshwater, speaks of the close relationship between breeding and migration and divides the freshwater fishes into migratory and non-migratory fishes of the plains and migratory and non-migratory fishes of the hills. The migratory forms produce a larger number of eggs as the chances of survival are less than that of the non-migratory among which also a difference is noticed in that the monogamous deposit fewer eggs than the polygamous. He says that the migration for breeding takes place when the water courses are flooded and that considerable destruction is caused to the young fish due to improper methods of fishing when the waters subside.

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[1] This article was communicated for publication early in 1944. The later publications on the subject will be given in the appendix at the end.

Beavan (1877) while writing about the freshwater fishes of this country gives brief notes on the breeding habits of Ophicephalids, Siluroids and Cyprinids.

Willey (1911) says that the floods provide natural close season for the river fishes.

It may not be out of place to mention here the findings of Stewart (1911) on the breeding and migration of the fish on the Tibetan side of the Himalayas at a height of 13,100 feet. 'The breeding in the neighbourhood of Gyantse appears to occur about June. In the less favoured waters near the water-shed it is probably somewhat later. Adults with large ovaries and testes are found in the former district as early as March when the river is particularly covered with ice and the smaller streams and channels are completely frozen over'. Again he says 'All the inhabitants of Gyantse whom I consulted in regard to obtaining fish agreed that the larger fish migrated from the Nyangchu to the Brahmaputra (Tsay-po) for the winter and returned to breed in spring. It is certain that I did not obtain any large fish during this season, but this fact also could be accounted for by the hibernation of either the fish or the fishermen'.

Annandale (1918) who investigated the fish and fisheries of the Inlé Lake, Burma, says that according to the Intha fishermen almost all the fish of the lake breed in February, March and April. He found ripe or nearly ripe roes in all the species examined at the end of February and in March.

Wilson (1920) gives the following note on the migration of the fish during the spawning season in the Bhavani River (S. India). 'The big fish run up to the spawning grounds in the upper reaches of the Bhavani during the South-west Monsoon as soon as the higher water begins decreasing during August, September and October according to the season'.

The observations of Annandale and Hora (1920) show that the fish of Seistan on the Persian frontier north of Baluchistan, breed in winter as young specimens were collected at that time.

Generally speaking we do not have except in North India the different seasons so distinctly marked as in the cold countries. Observations of the present writer are confined to South India and he has found that the spawning period of the freshwater and brackishwater fishes is rather extended in this region, more so on the West Coast than on the East Coast due to the presence of two monsoon rains. The peak period in the former region is by the onset of the monsoon in May and June and the breeding continues till November and December by which time the North-east Monsoon is over. The early showers towards the end of April and beginning of May give the first stimulus to the breeding activity. These rains flush the rivers and tanks; but the initial influx of water is not so great as to make them overflow. There is a marked increase in the planktonic organisms suitable for the growth of the fry and the absence of any floods at this time enables the eggs and fry to develop in comparative safety. By the onset of the regular rains the different waters get united and the fry as well as the large fish get themselves distributed. The condition is the same in both fresh water and brackish water areas and in the latter it has been seen that the breeding activity is at its maximum before the opening of the bars towards the end of June. Such of those marine forms that visit the estuaries or ascend rivers for breeding do so after the commencement of the regular rains when the bars are open. On the East Coast the breeding activity is at its maximum in August at the time of the early monsoon showers and it continues with intermittent intensity till about January. Among many of the South Indian fishes some degree of spawning is prevalent throughout the year especially in those parts where the climatic conditions do not show marked difference during the different parts of the year.

The fishes dealt with in this paper are listed below. The classification followed is that of Jordan[1], with the genera under each family and the species under each genus arranged alphabetically.

Super Order : TELEOSTEI.
  Order : ISOSPONDYLI.
    Sub-Order : *ELOPOIDEA.*
      Family : **Elopidae.**

        Elops indicus Swainson.

      Family : **Magalopidae.**

        Megalops cyprinoides (Broussonet).

    Sub-Order : *CLUPEOIDEI.*
      Family : **Clupeidae.**
        Hilsa ilisha (Ham.).
      Family : **Eugranlldae..**
        Engraulis purava (Ham. Buch.).
        Engraulis telara (Ham. Buch.).

    Sub-Order : *NOTOPTEROIDEI.*
      Family : **Notopteridae.**
        Notopterus chitala (Ham. Buch.).
        Notopterus notopterus (Pallas).

    Sub-Order : *SALMONOIDEI.*
      Family : **Salmonidae.**
        Salmo gairdneri Richardson.

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[1] Jordan, D. S. '*Classification of Fishes*', No. 2. *Stanford University Pub.* Vol. III, 1922-23.

Order : OPISTHOMI.

Family : **Mastacembelidae.**

Macrognathus aculeatus (Bloch).
Mastacembelus armatus (Lacep.).
Mastacembelus pancalus (Ham. Buch.).

Order : APODES.

Sub-Order : *ENCHELYCEPHALI.*

Family : **Anguillidae.**

Anguilla elphinstonei Sykes.

Order : EVENTOGNATHI.

Family : **Cyprinidae.**

Amblypharyngodon melettina (Cuv. & Val.).
Amblypharyngodon microlepsis (Bleeker).
Barbus ambassis (Day).
Barbus amphibius (Cuv. & Val.).
Barbus carnaticus (Day).
Barbus chola (Ham. Buch.).
Barbus conchonius (Ham. Buch.).
Barbus chrysopoma (Cuv. & Val.).
Barbus dorsalis (Jerdon).
Barbus filamentosus (Cuv & Val.)
Barbus gelius (Ham. Buch.).
Barbus lateristriga (Cuv. & Val.)
Barbus melanampyx (Day).
Barbus phutunio (Ham. Buch.).
Barbus sarana (Ham. Buch.).
Barbus sophore (Ham. Buch.).
Barbus stoliczkanus (Day).
Barbus terio (Ham. Buch.).
Barbus ticto (Ham. Buch.).
Barbus titteya (Deraniyagala).
Barbus tor (Ham. Buch.)
Barbus vittatus (Day).
Barilius bendelisis (Ham. Buch.).
Barilius gatensis (Cuv. & Val.).
Brachydanio albolineatus (Blyth).
Brachydanio nigrofasciatus (Day).
Brachydanio rerio (Ham. Buch.).
Carassius auratus (Linn.).
Catla catla Cuv. & Val.
Cirrhina mrigala Ham. Buch.
Cirrhina reba Ham. Buch.
Danio malabaricus (Jerdon).
Danio neilgherriensis (Day).
Esomus danrica thermoicos (Cuv. & Val.)
Esomus danricus (Ham. Buch.).
Garra ceylonensis ceylonensis (Bleeker).
Garra mullya (Sykes).
Gymnocypris waddellii Regan.
Labeo bata (Ham. Buch.).
Labeo calbasu (Ham. Buch.)
Labeo gonius (Ham. Buch.).
Labeorohita (Ham. Buch.).
Rasbora daniconius (Ham. Buch.).
Rasbora maculata Duncker.
Rasbora labiosa (Mukerji).
Rasbora rasbora (Ham. Buch.)
Rasbora taeniata Ahl.

Family : **Cobitidae.**

Botia geto (Ham. Buch.).
Lepidocephalichthys thermalis (Cuv. & Val.).
Nemacheilus notostigma (Bleeker).
Nemacheilus zonatus (McClelland).

Order : NEMATOGNATHI.

Family : **Siluridae.**

Callichrous bimaculatus (Bloch).
Wallagonia attu (Bloch).

Family : **Ariidae.**

Arius falcarius Richardson.
Arius jatius (Ham. Buch.).
Arius jella Day.
Arius sona (Ham. Buch.).
Osteogeniosus militaris (Linne).

Family : **Bagridae.**

Gagata cenia (Ham. Buch.).
Mystus aor (Ham. Buch.).
Mystus gulio (Ham. Buch.).
Mystus seenghala (Sykes).
Mystus vittatus (Bloch).

Family : **Claridae.**

Clarias teysmanni Bleeker.

Family : **Heteropneustidae.**

Heteropneustes fossilis (Bloch).

Family : **Sisoridae.**

Sisor rhabdophorus Ham. Buch.

Order : CYPRINODONTES.

Family : **Cyprinodontidae.**

Aphanius dispar (Rüppel).
Aplocheilus blockii (Arnold).
Aplocheilus lineatus (Cuv. & Val.).
Aplocheilus panchax (Hamilton).
Oryzias melastigma (McClelland).

Family : **Poeciliidae.**

Gambusia affinis holbrookii (Girard).
Lebistes reticulatus (Peters).

Family : **Horaichthyidae.**

Horaichthys setnai Kulkarni.

Order : SYNENTOGNATHI.

Family : **Belonidae.**

Tylosurus strongylurus (van Hass.).

Family : **Hemiramphidae.**

Dermogenys burmanicus Mukerji.
Hemiramphus gaimardi (Cuv. & Val.).

Order : LABYRINTHICI.

Family : **Ophicephalidae.**

Channa orientalis Bloch & Schneider.
Ophicephalus gachua Ham. Buch.
Ophicephalus marulius Ham. Buch.
Ophicephalus punctatus Bloch.
Ophicephalus striatus Bloch.

Family : **Polyacanthidae.**

Belontia signatus Gunther.

Family : **Osphromenidae.**

Betta splendens Regan.
Colisa fasciata (Bloch & Schnn.).
Colisa labiosa (Day).
Colisa lalia (Ham. Buch.).
Macropodus cupanus (Cuv. & Val.).
Osphronemus goramy (Lacép.).
Trichogaster trichopterus (Pallas).

Family : **Anabantidae.**

Anabas testudineus (Bloch).

Order : PERCOMORPHI.

Sub-Order : PERCESOCES.

Family : **Mugilidae.**

Mugil sp.

Sub-Order : RHEGNOPTERI.

Family : **Polynemidae.**

Polynemus paradiseus Linn.

Family : **Ambassidae.**

Ambassis lala (Ham. Buch.).
Ambassis miops Gunther.
Ambassis nama (Ham. Buch.).
Ambassis ranga (Ham. Buch.).

Family : **Latidae.**

Lates calcarifer (Bloch).

Family : **Theraponidae.**

Pelates quadrilineatus (Bloch).
Therapon jarbua (Forskal).
Therapon therapos (Cuv. & Val.).

Family : **Sillaginidae.**

Sillago sihama (Forskal).

Family : **Nandidae.**

Badis badis (Ham. Buch.).
Nandus nandus (Ham. Buch.).

Sub-Order : SQUAMIPENNES.

Family : **Toxotidae.**

Toxotes chatareus (Ham. Buch.).

Family : **Scatophagidae.**

Scatophagus argus (Gmel. Linn).

Order : CHROMIDES.

Family : **Cichlidae.**

Etroplus maculatus (Bloch).
Etroplus suratensis (Bloch).

Order : GOBIOIDEA.

Family : **Gobiidae.**

Acentrogobius neilli (Day).
Acentrogobius viridipunctatus (Day).
Ctenogobius acutipinnis (Cuv. & Val.).
Glossogobius giuris (Ham. Buch.).
Gobius ostericola Chaudhuri.
Oxyurichthys striatus (Day).

Family : **Periophthalmidae.**

Boleophthalmus boddaerti (Pallas).
Periophthalmus cantonensis pearsi Eggert.

Order : JUGULARES.

Family : **Blennidae.**

Petroscirtes bhattacharyae Chaudhuri.

Elopidae.

Elops indicus (Swainson).

Raj (1916) says that breeding is in the cold season and that the fry are ribbon shaped.

Megalopidae.

Megalops cyprinoides (Broussonet).

Thomas (1870) says that the breeding season of this fish in South Canara extends from May to June and Raj (1916) says that it breeds in the cold weather (October and November) and that it passes through the larval stage like that of an eel.

idae.

Among the clupeids the spawning habits of *Hilsa ilisha* or the so-called Indian Shad has engaged from the very early times the attention of the pisciculturists. Till the recent investigations of Hora, Prashad and Nair the habits of the fish were not known definitely. Their findings go to show that *Hilsa* actually reside in the rivers and that 'after leaving the rivers the fish do not go far into the sea but move about in shoals in the estuaries and along the foreshores'.

Hilsa ilisha (Hamilton).

Day (1873) has first referred to the migratory habits of this form, pointing out the fact that both young as well as sexually mature fish ascend the rivers. According to him the fish attains sexual maturity when about two years old and this is confirmed by the findings of the Madras Fisheries Department. He (Day 1878) has given the migratory period of the fish in some of the rivers of India and Burma and stressed on the destruction caused to these fisheries by the numerous weirs that span many of the Indian rivers devoid of fish passes which otherwise would enable them to get at the upper reaches of the rivers for spawning purposes. Wilson (1909) succeeded in artificially fertilising Hilsa eggs at Coleroon and this was the starting of a scheme towards the artificial propagation of this form. Jenkins (1910) gives notes on its habits in Bengal and there is a brief note by Raj (1917) on the artificial propagation in the Coleroon hatchery where he succeeded in liberating about 10 million fry from artificially impregnated eggs in August 1916. This work is being continued regularly by the Madras Fisheries Department (Devanesan, 1939).

The recent work of Hora (1938) on the spawning habits and bionomics of this form is a fairly detailed and comprehensive account embracing all the previous work done on this line with special reference to that done in Bengal and embodying the results of his own investigations, and a complete bibliography. The observations of Hora at Pulta, and of the Madras Fisheries Department in South India, go to show that the fish is capable of living in confined waters. The breeding period is extensive with a maximum during the rainy season.

Nair (1939) has described some of the early larval stages, 14 to 27 mm. in length collected from the Pulta Water Works, Calcutta, where the young are found in great abundance from March to November. Eggs and very early larval stages have not been collected from the Hooghly.

Hora (1940) refers to the importance of the conservation of Jatka fish, young Hilsa 2-5 months old, for the Hilsa fishery. He (1941) gives an account of the life history and habits of *Hilsa* in Bengal waters.

Engraulidae.

Engraulis purava (Ham. Buch.)

Raj (1916) refers to the occurrence of the young of this form in Cooum river, Madras, during October and November. Dr. T. J. Job and the present writer have collected the larvae of *E. purava* in March from Adyar, Madras.

Engraulis telara (Ham. Buch.)

Day (1878) gives the colouration of the pectoral fins of the young.

Notopteridae.

Notopterus notopterus (Pallas)

There is a note by Rao (1919) in which he says that the 'eggs adhere to each other and to the substratum on which they are deposited in clumps'. Nothing more regarding its breeding habits or development is known.

Notopterus chitala (Ham. Buch.)

Notes on the breeding habits and development of this form based on the observations made, and materials collected, by Mr. Hoshin at Buxar (Bihar) from the Ganges are given by Southwell and Prashad (1919). The eggs were collected in June and July 1915 and these were attached mostly to stones and masonry where they had been deposited by the female before fertilization. There is no elaborate nest building and the eggs measuring about 5.2 mm. in diameter usually number from three to five hundred and are circular with an adhesive surface which is raised into projections on one side. The eggs take about two weeks to hatch and there is parental care but which of the parent takes the main part is not known. The breeding of this fish probably extends from the end of May to the middle of July.

Salmonidae.

Salmo gairdneri Richardson

There is an interesting and exhaustive account on trout culture in Ceylon by Fowke (1938) wherein notes on the life-history of the trout acclimatized in the Ceylon waters is given. The observations of Fowke throw considerable light on the identity of the species and he has given sufficient reasons to show that the Trout in Ceylon is not the Rainbow (*S. shasta*) as is generally believed to be but the Steelhead. The article provides interesting and instructive reading and may be gone through with advantage.*

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* For a comprehensive account on trout culture the 'Domesticated Trout' by Livingston Stone may be consulted.

Mastacembelidae.

Mastacembelus panacalus (Ham. Buch.)

Raj (1916) gives the description of an immature fish and mentions the cold season as the breeding period. Job (1941) gives a detailed account of the breeding habits and development of this form and according to him the fish breeds in Bengal from May to November with the peak period during the premonsoon rains. The eggs are transparent and measure 1.3 to 1.35 mm. in diameter and are laid feebly attached to algae. Hatching takes place 36 hours after oviposition and there is no parental care. The early larval development is rather rapid and the fish acquires adult characters by the end of the first month. Sexual maturity is attained in about an year.

Mastacembelus armatus (Lacép.)

Raj (1916) records mature ova in a specimen he collected early in February 1910. Derainyagala (1930-32) gives a number of places in Ceylon from where young specimens, and fish with mature eggs were collected. The writer has collected young specimens of this fish in August 1938 from a tank in Central Travancore.

Macrognathus aculeatus (Bloch)

Deraniyagala (1930-32) describes the eggs and gives a number of places in Ceylon from where sexually mature specimens were collected.

Anguillidae.

Members of this family are known to migrate to the sea for breeding purposes and the young ones after passing the larval (Leptocephalus) stage in the sea ascend rivers during the elver stage.

Auguilla elphinstonei Sykes.

According to Raj (1916) the elvers ascend the Adyar and Cooum rivers in Madras about the month of November.

Cyprinidae.

This family embraces the Carps, the most important group of fresh-water fishes in India. Though complete life histories of only a very few forms are known we have notes on the breeding habits of a number of them. The intensive sexual activity and migratory habits of these fishes soon after the first monsoon rains are well known. They are so reckless at this time that they are captured with comparative ease by fishermen. Thomas (1870 and 1897), Day (1873 etc.), Beavan (1877), and Jones (1940) have mentioned about the spawning activity of Cyprinids. This has been a familiar and favourite subject of study for many naturalists. Khan (1924, 1926, 1939 & 1943) has made some interesting studies on the spawning habits of some of the Punjab forms and the present writer has worked out the life histories of two forms in Ceylon (Jones, 1938 a & b). As Khan (1926) says, 'To this group belongs a vast number of edible and sporting fishes and their culture should be the main object of a pisciculturist'.

Beavan (1877) says that 'the Mahseer and many other Cyprinoid fish, are said not to deposit their spawn all at once like the salmon, but in several batches during a period of several months, say from May to August'.

Some of Khan's (1924) observations are given below:—

'All attempts to breed members of the family Cyprinidae, namely *Labeo rohita, L. calbasu, Cirrhina mrigala* and *Catla catla* in artificial waters have proved failures. Unlike their western species they do not lay their eggs, even when brood fish from river are introduced into the tanks. The experiments were tried at the departmental hatcheries at Madhopur but no result was obtained. One of the main reasons for our failures is the want of knowledge of their breeding habits in their natural environments.'

'The fish become ripe in May and both the male and female seek shelter under weeds and aquatic plants near banks and are not easily frightened by the approach of intruders. Towards evening group of fish may be seen splashing water and fighting with each other. These are signs of courtship! And thus they wait for the first shower of rain. If there is no rain at all or if they are late the eggs degenerate in the ovaries, leaving a filthy mass. In July as soon as the rains set in, the streams become flooded and the fish move on to shallow waters. If the flood is of a temporary character they fall back into the main channel with the diminishing current without spawning, but if the floods are continuous the fish get into the surrounding fields, play together, lashing the water with their caudal portions. A female is often followed by three or more males, but reverse cases have also been observed. Very rarely are single couples seen. If male is separated from a companion or is companionless it has been heard to produce guttural sounds calling the other. This play lasts only for a short time and the female then lays its eggs which are nonfloating and the males shed their seminal fluid or milt over or near them. Depth of water in fields where spawning takes place varies from three inches to two feet, and temperature of water ranges from 76° to 98° F. Sometimes when the flood subsides early, little pools are formed by the depression and there the eggs are found in heaps'.

'The eggs are not laid at one place and at the same time, but at intervals during which the fish keeps on moving with its mates along with the current of water. The rivers are flooded first and the fish therein are the first to spawn while those of the tributaries wait for heavy rains which flood them sufficiently to overflow into the fields where spawning takes place. The breeding time thus lasts from the beginning of July to the middle of August'.

Khan (1938 a) says that the breeding time for the Indian Carp is June and July when the rivers are flooded by the monsoon rains. Administration of extract of anterior lobe of the pituitary gland hastened ovulation in *Cirrhina mrigala* and as such under natural conditions the pituitary sex hormone is discharged into the blood prior to ovulation though the factors responsible for this gland activity are not known.

It may be mentioned here that the author has been able to collect the eggs of a number of Cyprinids, from fresh water tanks and lakes in Travancore, which are not described here as their parentage has not been ascertained. The embryonic period is of very short duration as in the other members of the family, some hatching out within twelve hours. In two species two very interesting types of larval 'cement organs' the like of which have not been recorded in any other fish have been observed. (Jones. 1942).

Labeo calbasu (Ham. Buch.)

Mukerjee (1943) says that the fry have yellow bands at the nape, a yellowish spot at the place of insertion of the dorsal fin and yellow colour, sometimes alternating with the black of the body whereas the adult is completely black.

Labeo genius (Ham. Buch.)

Khan (1924 & 1926) has given notes on the embryonic and early development of this form till it is three weeks old, when the caudal fin get separated off and scales appear. The eggs, which are bluish in colour, hatch in about 30 to 40 hours and mouth, gut and anus are absent in the larvae at this stage. Mukerjee (1943) gives a note on the colouration of the fry.

Labeo rohita (Ham. Buch.)

Mukerjee (1943) says that the fry have three small spots in the caudal region which gradually merge into one and ultimately disappear in the adult.

Labeo bata (Ham. Buch.)

Mukerjee (1943) refers to the presence of a spot on the 5th and 6th scales on the row just above the lateral line in the fry.

Barbus sarana (Ham. Buch.)

Mukerjee (1943) refers to the presence of a linear band on the back below the insertion of the dorsal fin which gradually gets rounded and disappears in the adult.

Barbus chrysopoma (Cuv. & Val.)

According to Day (1878) the eyes in the young are comparatively large. Raj (1916) says that the breeding season at Madras is about December as the young are common in January and February. He gives the description of specimen one inch long. Deraniyagala (1930) has collected young in December in Ceylon.

Barbus tor (Ham. Buch.)

The migratory habits of this form for breeding purposes are well known, and being a game fish as well as food fish it has engaged the attention of naturalists and anglers from very early times. According to Beaven the fish lays its eggs in several batches for a long period mainly from May to August. Thomas (1897) gives in detail the migration and breeding habits of this fish. According to him, the fish ascend the rapids and eggs are laid there after which they return with the receding floods. His opinion was that the Mahseer* lays several batches of eggs probably three in one season. Khan (1924) also refers to the migratory habits of this form during breeding season, and in the Punjab the fish has been found to ascend the rivers and traverse long distances in March and April. Deraniyagala records his collection of gravid female, and young specimens from a number of places in Ceylon (Deraniyagala 1930). Khan (1939) has made an interesting study of the sex organs of this form and in conclusion says that the fish 'seems to spawn *firstly* in winter, in January and February, *secondly*, in May and June, when the snow melts and the rivers are swollen, and *thirdly*, from July to September, when the rivers are flooded with the monsoon rains'. He refutes the opinion of Thomas (1897) that the fish lays eggs in batches and says as follows: 'It may, therefore, be said that the Mahseer does not lay its eggs in three batches, but that it spawns three times in the year, and that all the eggs in the ovaries are laid at each spawning season'.

Barbus sophore (Ham. Buch.)

Day (1878) records the presence of 1850 mature eggs in a female at Madras in January. Raj (1916) says that it breeds during the cold weather and the young are common in November and December. He gives some of the larval characters.

Barbus carnaticus (Day)

Day (1878) mentions some of the characters of the young of this form.

Barbus melanampyx (Day)

The writer has observed large numbers of the young of this fish in hill streams in Travancore in the months of August and September 1940.

Barbus chola (Ham. Buch).

Notes on the breeding habits of this fish is given by Innes (1935). Stoye (1935) says that the habits are similar to that of *B. conchonius*.

Barbus dorsalis (Jerdon)

Willey (1911) describes a collection of unfertilized eggs from the Colombo lake. According to Raj (1916) the spawning season in Madras extends from August to October. Deraniyagala (1930) gives the names of the places in Ceylon from where he collected ripe females, and young with the corresponding dates.

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* Mahseer is the popular name given to most of the large scaled Carps of the Genus *Barbus*.

Barbus amphibius (Cuv. & Val.)

According to Thomas (1870) this form breeds during October, November and December in South Canara. Raj (1916) observes that its breeding season is during June and July in Madras. He gives the colouration of the young.

Barbus ambassis (Day)

According to Spence and Prater (1932) breeding season is as in *Barbus filamentosus*.

Barbus conchonius (Ham. Buch.)

The breeding of this fish in the aquarium is given by Baake (1930) and by Innes (1935). According to the latter it is easier to breed this fish than *B. chola*. Mellen & Lanier (1935) and Stoye (1935) also give the breeding of it in the aquarium. It begins to breed when five months old and lays 150 to over 600 eggs scattered among the vegetation and the fry hatch out in about one and a half days at a temperature of about 70 to 75° F. The fry cling on to plants and sides of the aquarium indicating the presence of cement glands. The young seem to have cannibalistic tendencies.

Barbus ticto (Ham. Buch.)

Innes (935) gives the distinguishing characters of the sexes during the breeding season. Mellen and Lanier (1935) and Stoye (1935) say that the breeding habits resemble those of *B. conchonius*. Spawning temperature is 80° F. and from 150 to 300 eggs are laid scattered among the vegetation. Fraser (1937) refers to the presence of very young specimens at Deolali in November and egg bearing females in March. Khan (1938) says that this fish and *B. stigma* breed in July and August in the Punjab and the eggs which are small hatch out in 18 to 20 hours and the young begin to seek their food after a week.

Barbus stoliczkanus (Day)

Innes (1935) says that this species is said to be prolific and as hardy as *B. ticto*. According to Mellen & Lanier (1935) and Stoye (1935) the breeding habits are similar to those of *B. conchonius*. The spawning temperature is 80° F.

Barbus gelius (Ham. Buch.)

Innes (1935) refers 75° F. as the optimum temperature required for the breeding of this form and Mellen & Lanier (1935) give it at 80° F. Stoye (1935) gives some notes on the breeding of the fish in the aquarium. All refer to the spawn eating tendency of the parents. The embryonic period is 36 hours and the larvae are probably provided with adhesive glands.

Barbus phutunio (Ham. Buch.)

Notes on the breeding habits in the aquarium are given by Innes (1935). Mellen & Lanier (1935) say that the breeding habits are similar to those of *B. conchonius*. It breeds at 76° F. and the embryonic period is from 30 to 40 hours. Stoye (1935) gives similar notes on the fish under aquarium conditions.

Barbus terio (Ham. Buch.)

According to Innes (1935) the breeding and care of this fish is the same as in the case of *B. conchonius* though it does not spawn so readily.

Barbus vittatus (Day)

Day (1878) gives the coloration of the very young specimens. Innes (1935) says that this is a good breeder in the aquarium. Mellen and Lanier (1935) say that though the sexes are difficult to be distinguished the colour of the male becomes more vivid and the abdomen of the female becomes deeper during the breeding season. The breeding habits are similar to that of *B. conchonius*, 50 to 250 eggs are laid and the spawning temperature is 78° F. Stoye (1935) says that this fish is not so prolific as *B. conchonius*.

Barbus filamentosus (Cuv. & Val.)

Deraniyagala (1930) lists a number of places in Ceylon from where he collected gravid females. Spence and Prater (1932) say that in Bombay and its neighbourhood the breeding is in December and that the young are found in January.

*Barbus lateristriga** (Cuv. & Val.)

Mellen and Lanier (1935) give 80° F. as the spawning temperature in the aquarium and Stoye (1935) gives the distinguishing characters of the two sexes during breeding season.

Barbus titteya (Deraniyagala)

Deraniyagala (1930) has collected young from different places in Ceylon.

Cirrhina reba (Ham. Buch.)

Mukerjee (1943) says that the fry differs from the adult in having three spots in the caudal region which later on unite with a lateral blue black line in the adult.

Cirrhina mrigala (Ham. Buch.)

According to Khan (1926) the eggs are light red and the development as that in *Labio gonius*. He (1943) has given a detailed account of the early development of this fish in the Punjab. The breeding is in July as in other carps and a female contains 124,800 to 216,800 eggs. The young gets adult characters in a month. Mukerjee (1943) gives a note on the difference in colouration between the fry and the adult.

Garra ceylonensis ceylonensis (Bleeker)

Deraniyagala (1930) records with their respective dates a number of places from where young of this form was collected by him in Ceylon. The life history of this form has been worked out by Jones (1938 & 1941). The embryonic development was worked out in Demodera, Ceylon. Soon after hatching, the larvae were brought down to Colombo and from there to Tambaram (Madras). One of the surviving young fish when about 5 months old was brought to Trivandrum from Madras where it lived for another 3 months. Thus the larval and the post-larval development has been worked out in India.

Garra mullya (Sykes)

Fraser (1937) records the presence of egg bearing females in Deolali in the month of March 1936. Jones (1941) has described an interesting case of migration of this fish for breeding in large shoals in one of the up-country rivers in Travancore in the month of April. The early development of the fish is similar to that in *Garra ceylonensis ceylonensis*.

Barilius bendelisis (Ham. Buch.)

Day (1878) refers to the large sized nature of the eggs and the breeding of this form at Cuttack in November. Fraser (1937) has observed gravid females in March.

Barilius gatensis (Cuv. & Val.)

Day (1878) gives the difference in the scales of the females and young from that of the male.

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* This is a native of the East Indies and has been introduced into India as an aquarium fish.

Danio malabaricus (Jerdon)

The breeding of this species in the aquarium is mentioned briefly by Innes (1935) and Mellen & Lanier in (1935) and Stoye (1935). The breeding habits and early development of this form in Ceylon were worked out by Jones (1938). The presence of a cement organ recorded for the first time is another feature of interest. The developmental study was carried out at Demodera (3000 ft.), Uva Province, Ceylon, during the months of April, May and July, 1937. Young fish of different stages were abundant at this time in the streams there showing a long period of breeding.

Danio neilgherriensis (Day)

Day (1878) mentions the presence of light horizontal bands in the young.

Carassius auratus (Linn.)

This beautiful fish introduced from the Far East is a very common aquarium form now in India. Khan (1928) gives notes on the spawning and development of this form. According to him it breeds at frequent intervals (in the Punjab) from April to August and the eggs hatch out in 46 to 60 hours. Three months old fry assume the coloration of the adult. There are several accounts on the breeding of this fish in other countries (see Mellen & Lanier, 1935, for references.) From 2000 to 70,000 eggs are laid in a year according to the size of the female and eggs are small and resemble soap bubbles. The parents are spawn eaters and the young are cannibalistic. 60° to 70° is the spawning temperature.

Esomus danrica thermoicos (Cuv. & Val.)

Deraniyagala (1930) refers to his collection of fishes with mature ova from Athidiya, Ceylon, early in April, 1929.

Esomus danricus (Ham. Buch.)

The spawning habits of this fish in the aquarium are described by Innes (1935) and by Mellen & Lanier (1935) and Stoye (1935). The spawning temperature is about 80° F. and 75 to 250 eggs which are small and pale yellow in colour are laid feebly attached to plant. The parents are spawn eaters and the eggs hatch in two to three days.

Catla catla (Cuv. & Val.)

Raj (1916) says that in Godavari River this form breeds about August and young specimens are common in January. He refers to the rapid growth as observed by Mitchell (1875). Mukerjee (1935) says that in the fry the red tinge of the gill filters out through the transparent operculum. Though this fish grows well in still waters it does not breed there.

Amblypharyngodon microlepis (Bleeker)

According to Raj (1916) the breeding season extends from October to December at which time he says the fry are quite common. He gives a description of the fry.

Amblypharyngodon melettina (Cuv. & Val.)

Willey (1911) says that females three inches long are found egg-laden in December in Ceylon. Deraniyagala (1930) refers to the development of a cutaneous symphysal flap over-lapping the upper jaw during breeding seasons.

Rasbora daniconius (Ham. Buch.).[1]

Raj (1916) observes this to breed during rains in September and October in Madras, where it is common during the breeding season along with the fry of *Amblypharyngodon, Nauria danrica* and *Barbus vittatus.* Deraniyagala (1930) collected gravid females from a number of places in Ceylon. Innes (1935), Mellen and Lanier (1935) and Stoye (1935) give notes on the breeding of this fish in the Aquarium. The spawning temperature is 80° and eggs are attached to fine plants.

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[1] The development of this fish has since been worked out by the author.

Rasbora rasbora (Ham. Buch.)

According to Thomas (1870) this form breeds in June and July in the West Coast.

Rasbora labiosa Mukerji.

Hora (1937) has collected young of this form in November, and gravid females in February.

Rasbora maculata Duncker.

Mellen and Lanier (1935) say that the spawning temperature is 80° and that the eggs are deposited on the under surface of leaves. Stoye (1935) gives the distinguishing features of the male fish.

Rasbora taeniata Ahl.

The spawning temperature of this fish is about 80° and about 250 eggs are laid at a time. (Innes, 1935, Mellen & Lanier, 1935, and Stoye 1935.)

Gymnocypris waddellii Regan.

Stewart (1911) says that in the ripe specimen the mature ova attain the impressive size of 2.5 mm.

Brachydanio rerio (Ham. Buch.)

Innes (1935), Mellen and Lanier (1935) and Stoye (1935), give notes on the breeding of the fish in the aquarium and the method of rearing of the larvae. Innes (op. cit.) refers to the occurrence of sterile hybrids of *B. rerio* and *B. nigrofasciatus.* The male is brightly coloured during the breeding season and from 150 to 350 transparent eggs are laid by the female. The parents are spawn eaters. The larvae come out in about 2 days and appear to be provided with adhesive glands which enable them to cling to the sides of the aquarium for about two days. The spawning temperature is about 80°

Brachydanio nigrofasciatus (Day)

The breeding habits of this species are given by Innes (1935) and Mellen and Lanier (1935) in the aquarium and they refer to the difficulty of breeding it. The spawning temperature is about 80°. Stoye (1935) gives notes on the breeding of the fish.

Brachydanio albolineatus (Blyth)

Baake (1930) gives notes on the care of this fish in the aquarium and its breeding habits. Innes (1935), and Mellen and Lanier (1935) also refer to the breeding of this fish in the aquarium which are similar to those of *B. rerio.* The young develop rapidly and attain sexual maturity in six months. Stoye (1935) says that the breeding habits are similar to those of others of the group.

Cobitidae.

Nemachilus zonatus (McClell.)

Day (1878) gives the colouration in the young.

Nemachilus notostigma Bleeker

Deraniyagala refers to his collection of young of this form in Ceylon.

Lepidocephalichthys thermalis (Cuv. et Val.)

Day (1878) records the presence of 2,500 eggs in a female. According to Raj (1916) the breeding season in Madras extends from October to January. Deraniyagala (1930) has collected gravid females in Ceylon.

Botia geto (Ham. Buch.)

Day (1878) gives the larval characters of this form.

Siluridae.

Wallagonia attu (Bloch)

Khan (1924 & 1926) has given notes on the early development of this form and Ahmed (1934) gives a brief note on its embryology. Deraniyagala (1930-32) has collected female specimens with mature ova from Kelaniya (Ceylon) on 25-2-27. The present writer has taken a very young specimen from a tank in Trivandrum during the middle of May 1938. According to Khan the eggs are yellowish and hatch out in twenty-four hours. The fry is omnivorous with cannibalistic tendencies.

Callichrous bimaculatus (Bloch)

Rao (1919) gives a short note on the development of this form. Deraniyagala describes the eggs and records the collection of ovigerous females and young specimens in Ceylon.

Arlidæ

The buccal incubation recorded in some of the members of this family whose breeding habits are known is so interesting that it practically eclipses the parental solicitude displayed by other fishes. The eggs are heavily yolked, large in size and few in number and these are carried in the mouth of the male. They are aerated by the respiratory current of water and the egg bearing male never feeds during this period. The larvae are also carried inside the mouth until they are able to take care of themselves. Notes on the spawning habits are given by Day (1878), Willey (1910), Jenkins (1910), Raj (1916), Deraniyagala (1930-32), and Chidambaram (1941).

Arius falcarius Richardson.

Willey (1911) has recorded the buccal incubation in this form and gives a description of the eggs and the egg carrying males. Raj (1916) gives the breeding habit according to which the spawning season extends from September to November, when large numbers congregate in estuaries to deposit their spawn.

Arius sona (Ham. Buch.)

This is a marine and estuarine form and Day (1889) gives the characters of the young specimens.

Arius jella (Day)

Chidambaram (1941) describes in some detail the parental care and early development of this fish at Madras where the breeding extends from August to March. The eggs are heavily yolked and yellowish green in colour and measure from 10 to 10.5 mm. in diameter. Soon after oviposition the eggs are fertilized by the male and transferred to its mouth where they undergo the embryonic development. They hatch after a month and the larvae continue to remain inside the buccal cavity for about another month by which time the yolk sac gets completely absorbed. The male does not feed during the whole period.

Arius jatius (Ham. Buch.)

Jenkins (1910) records the capture of a larvae-carrying male while shrimp trawling in the Culputtoa River in Khulna District.

Osteogeniosus militaris (Linne)

This is a marine and estuarine form and Jenkins (1910) describes the egg and parental care of this species. Similar notes are given by Deraniyagala (1930-32) according to whom *O. sthenocephalus* Day is probably a sexual modification of *O. militaris.*

Bagridae.

Mystus vittatus (Bloch)

Raj (1916) refers to his collection of ovigerous females in the month of March.

Mystus gulio (Ham. Buch.)

According to Day (1878) and Willey (1911) the eggs of this species are small sized as in the related forms. Eggert (1930) suggests that the female of this form may have the habit of carrying the eggs in the folds of its abdominal skin.

Mystus aor (Ham. Buch.)

Raj (1940) has recorded for the first time the interesting breeding habits of this form. It is suspected that the eggs are incubated by the male attached to its ventral side which is thrown into vascular folds. The young on hatching out remains in a shoal under the parent and for some period appear to get nourishment from a white fluid exuding from the highly vascularised villiform processes of the ventral surface. Some of the larval stages of the fish are described.

Mystus seenghala (Sykes)

Raj (1940) infers from his observations that the breeding habits of this species is similar to that of *M. aor.*

Gagata cenia (Ham. Buch.)

Day (1878) refers to some small specimens he examined from Darjeeling.

Claridae.

Very little is known about the breeding habits and early development of fishes belonging to this family.

Clarias teysmannii (Bleeker)

Deraniyagala (1930-32) describes the colour of the eggs and records the dates of collection of ovigerous females in Ceylon.

Heteropneustidae.

Heteropneustes fossilis (Bloch)

Day (1878) describes the ova from an ovigerous female captured at Bezwada. According to Deraniyagala (1930-32) this form spawns all the year round.

Sisoridae

Sisor rhabdophorus (Ham. Buch.)

Day (1889) says that the young of this has the habit of remaining under stones.

(*To be continued.*)

NOTES ON THE INDIAN MAHSEERS.

BY

K. DE B. CODRINGTON.

In Vol. xli (Nos. 2, 3 and 4) and Vol. xlii (No. 1.) of the *Journal of the Bombay Natural History Society,* Dr. Sunder Lal Hora continues his researches upon the Indian Mahseers. In his prefatory papers in Vol. xxxix of the same *Journal,* he confesses that 'the precise generic and specific limits of the forms included under this composite term' are not easy to define. He also stresses the want of field observations, especially from anglers. The following notes are based upon plentiful catches recently made in the Ghorband, Kurram, Swat, Jhelum, Chenab, Sutlej and Kistna rivers, and in certain of the Indian lakes and other enclosed waters. Although I have collected fish elsewhere, I must confess that I found the preservation and transportation of specimens of Mahseer impossible under war-time Indian conditions. I suggest that it would be profitable to issue simple directions for dissection to collectors, so that information as to the condition of the ovaries could be recorded photographically.

1. *Nomenclature.*

Dr. Hora recapitulates the current explanations of the name Mahseer, and in doing so quite rightly disposes of a good deal of bad etymology. Dr. Chhabra's rejection of the derivation from Persian Mahisher is interesting; he points out that the Persian compound should properly be Shermahi. One of the common Barbels of Afghanistan, of which I sent specimens to Dr. Hora from both sides of Hindu Kush, is actually known as Shirmahi, but it has neither a big head nor is it a lion-hearted fish. Dr. Hora makes it plain that many of the dialect names of the Mahseer refer to its big scales, but he might have added to the Bengali Mahasaul (Mahasalkalin) the common Marathi name Masla (Mahasala) which is corrupted into Kawli massa, 'the scale fish'. Again, in Afghanistan, the Mahseer is known in Persian as Mahipatra, which, also, means 'scale fish'. The fitness of the term is clear and it is not surprising that it is used from the Kistna to Bengal to Afghanistan. On the other hand the Tamil name Bom-min (Pon-min) identifies the Mahseer as 'the gold fish'.

2. *Area.*

The eastern limits of the Mahseer are extensive but vague. It certainly exists in Burma and friends of mine from Siam and the Philippines have professed to recognise Dr. Hora's excellent plates. However, leaving aside the known African species and possible Mesopotamian relations, the western boundary of the Indian Mahseer species is clearly defined. They exist in the Hub and other rivers in the neighbourhood of the Karachi coast. They are found in the rivers of Baluchistan, Waziristan, in the Gomal and the Gumti and the Kurram, and I have caught specimens myself at Begram, near Charikar on the united Ghorband and Panjshir Rivers in Afghanistan, as well as in the Kunar (Chitral) River below Kila Drosh. Local fishermen at Begram, who are familiar with the Mahseer, though somewhat uncritical of its specific points, say that it does not run very far up the Ghorband and is not found at all in the Panjshir itself. It is not found, or recognised, in the Helmand river or in the tributaries of the Oxus system. It seems clear that the Hindu Kush-Kabul Kohistan watershed is its western limit in this region, as it is the eastern limit of the Oxus trout. With reference to trout in Asia, it is well worth noting that everywhere in India this fish is a western importation. The Kurram was stocked with trout from Kashmir; but it is perhaps also worth recording that H.R.H. Shah Ahmad Khan recently put some Oxus trout in a tank in his garden in Paghman near Kabul. With regard to the Kabul Valley, the Mahseer is not found in the Kabul River above the Tangi Garu falls, or in the Logar. Nor does it occur in any of the Kabul Kohistan streams, which are drained dry by irrigation canals and do not communicate with the Ghorband-Panjshir-Kabul system, except when in spate.

3. *Migration.*

The Mahseer is generally treated of as being a migratory fish, running up river to spawn. The suggestion that it does not run up the Ghorband much above Begram or up the Chitral River above Drosh, which I believe to be true, indicates an upper limit of migration of about 6,000 feet altitude for those latitudes. With regard to peninsular India 'Skene Dhu' (*The Angler in India,* 1923, p. 19.) records that it is not to be found in rivers rising below 1,000 feet above sea level. This suggested lower limit is probably too low, but I did not find the fish, or any knowledge of it, in the Manjira River system, a tributary of the Godavari in Hyderabad State. Moreover, the whole question of the altitude limits of tolerance of the Mahseer, and of its migratory nature, is complicated by the undoubted fact that in many parts of India, Mahseer are found in lakes and artificial tanks at varying altitudes. I have caught small Mahseer virtually at sea level in the Kolak River, north of Bombay, though I believe this river is open to upward migration to a fair altitude (1,300 ft. ?). On the other hand, many of the canals in Northern India have Mahseer in plenty, which cannot possibly migrate to higher spawning beds. Even where there are fish-ladders, I have never been able to convince myself that they are effectively used. This is a subject of some importance. These canal Mahseer undoubtedly develop normal ova, but until direct evidence of spawning is available, it should not be assumed that their spawn is viable. Fry in great numbers are washed through the upper canal head-works during the spring and summer floods, and these are quite sufficient in number to maintain a dense population. These semi-isolated fish may be compared with the Mahseer of such rivers as the Kistna, which during the hot weather, are reduced to un-connected chains of pools. The great, high altitude lakes, such as the Kumaon Lakes or Bhandaradara in the Ghats above Bombay, are clearly fertile breeding-grounds, but fresh observations are urgently needed with regard to the sacred fish preserved in small artificial tanks, such as that at Hassan Abdal near Rawal Pindi. It is difficult to see how these fish are propagated. I have never been able to find any evidence that such tanks are restocked.

The extant evidence may perhaps be summarised by saying that the upper altitude range of the Mahseer seems to be limited in terms of a minimum temperature. In other words, the Mahseer does not like cold which is the reason why, in December and January, they congregate in their hundreds at the head of the famous Jungoo Pool at Tangrot, near the Jhelum-Poonch junction, where there are warm springs. On the other hand, they flourish throughout the whole range of water temperatures normal to peninsular India.

Since taxonomy cannot be divorced from environmental considerations, it would seem advisable to pay special consideration to the lake, tank and canal types of Mahseer. On the other hand, it is quite clear that the Mahseers of the great rivers of the North of India are migratory, though the causes of the upstream and downstream movements are not yet intelligible. For one thing, it is assumed that the spawning grounds lie upstream. Analogies based upon the habits of the salmon are obviously unjust, but, remembering the critical altitude—temperature factors controlling the viability of trout spawn—the assumption may be accepted as an optimum tendency. On the other hand, direct observations of the spawning of the Mahseer are almost entirely wanting, and a certain conflict of evidence as to the times of migration and the seasonal development of the ovaries must be taken into consideration. Thomas (*The Rod in India*, p. 42.) put forward the theory that the Mahseer dropped its spawn by batches, repeating the process several times in the year. There does not seem to be any evidence for this, beyond the fact that Mahseer are caught in varying states of ovarian ripeness throughout the year. Recently Hamid Khan in Vol. xli of the *Journal of the Bombay Natural History Society*, has suggested that there are three distinct spawning seasons, (1) January and February, (2) May and June and (3) July to September, the monsoon flood months.

Sufficient evidence is obviously wanting, but after opening over a hundred well-grown fish caught in the Jhelum throughout the year, I can find no confirmation for a May-June breeding season. The state of the ovaries of fish caught at Tangrot in late November suggests a minor breeding season in January-February in those waters: while there is a good deal of evidence for what I take to be the major breeding season in August in the upper Jhelum and Wular Lake. The fishermen at Tangrot insist that there are no adult Mahseer there from late June to late September. I, myself, have fished at Tangrot in early June, when Jungoo was unpopulated and the junction Pool empty of big fish. I have followed the river downwards from Ningle on the Wular Lake, which I found empty in the last week in June, to Domel and saw the first shoals (Punjabi, *Toli*) pass Rampur a week later. I have returned to Tangrot in the last week in September to see the first sizeable fish appear in the junction Pool and Jungoo. Moreover, I examined the higher pools of the Poonch on the same day as the first shoal showed in Jungoo, and found fish at Chak, six miles up, the intervening pools being empty. It would, therefore, seem to be true that the fish, which congregate in thousands at Tangrot during the cold weather, run up either the Poonch or the Jhelum in May and June and return in September.

4. *Breeding in terms of Migration.*

It is important that the conditions of the normal cycle of movement should be examined. Fortunately in the cold weather until February, the Poonch at Tangrot is crystal clear, and its pools can be examined in detail, wherever the banks are high enough to enable one to look down. The fishermen say that the small fish are the first to arrive in September and the last to leave in June; and the Tangrot Fisherman's Records also suggest that this is so. In many places in the Jhelum above Domel, there are fish-jumps. I watched one of these, three miles below Rampur, in the first week in July, and saw hundreds of fish pass upwards. Before Kashmir State developed the timber trade, it seems that the fish arrived in these reaches much earlier, but now in June the river is a mass of floating logs, the effect of which can be seen in the scarred and battered fish caught at all seasons; one-eyed fish are noticeably common.

The upper Jhelum is, on the whole, a clear water river, the snow-water settling in the Wular basin. Snow-water floods occur on the Poonch from the end of February to the end of April. Rain floods begin in June, when the monsoon breaks, and continue until well into August. The water is then thickly coloured by the river's muddy tributaries, the Kunhar being especially turbid. Since the fish do not begin to move upstream until shortly before the rain-floods, it is difficult to see how there can be a summer spawning season, as Hamid Khan suggests. The mass of water and the speed of the current forbid it. By the end of August the river is clear and the water has fallen considerably. It continues to fall until the snow-floods start in the Spring. In May, between the snow-floods and the rain-floods the water again falls considerably. The available evidence seems to me to suggest that there are two breeding seasons on a migratory basis:—at low water in January and February in the lower Poonch at Tangrot; and in August in the Upper Jhelum and the Wular Lake.

It is important to realise that small Mahseer are to be caught in the lake at all times. The fishermen of Sopore catch them, illegally, on long lines, and I have seen them taken from the water in June, before the migratory fish arrive from the lower reaches. Furthermore, among the small fish to be caught at Tangrot in late May and September are large numbers of obviously juvenile fish. They are of slim proportions and have a pearly lustre, which is quite unlike the livery of the mature fish, and is indeed, unmistakable. Although I have frequently caught small Mahseer of 1½ lbs with developed ova, these juvenile fish are all immature. In September they are seldom much over a pound in weight, but in June I have caught them up to 7 lbs with rudimentary ova. It is possible, therefore that the fish spawned in the early Spring at Tangrot do not migrate until they are yearlings. Unfortunately there is no evidence, for the summer flood months at Tangrot, when the floods forbid netting and the colour of the water makes rod-fishing impossible. But it is certainly true that the Mill Reach above Jungoo, where a little stream joins the Poonch, is plentifully supplied with infantile Mahseer, from 4 ins to 8 ins in length at all other times. I must, however, admit that I have never seen Mahseer fry in the upper Poonch or Jhelum, though I have thought I have identified them in the pellucid, colourful depths of the Wular Lake.

I have one further piece of evidence as to the migration of the Mahseer. On Christmas day, 1941, Major Roger Bacon, then Political Agent, Khyber, saw many large fish trying to pass the head-works of the Upper Swat Canal at Amandara. In the first week in February I myself saw the same thing. There were at least two dozen fish in the pool below the dam. Neither Major Bacon nor I were able to land one of these fish. It is worth noting that it is usually said that the Mahseer leave the upper Swat river in October and that its waters are empty till April. This is evidently not so. Indeed what Major Bacon and I saw, suggests a tendency to work up stream in early spring; and this tendency is probably instigated by the fact that the best breeding grounds lie up-stream.

5. *Taxonomy*.

I can add very little to the discussion of the specific arrangement of the Indian Mahseers, except to point out that, from the point of view of behaviour, they are all of a kind. As a genus, they provide the fishermen with a single problem. Here a clear distinction must be drawn between the large mouthed Barbus species and the small mouthed. Fishing for Mahseer is altogether a different proposition from fishing for *Barbus jerdoni* or *Barbus dobsoni*. Of the Mahseers, two of the reported species seem to me to be well-established—the Bokar of the Assam rivers and the dark green, tubby fish of the Kistna. My notes on both these fishes show a remarkable consistency of colour, size, scale and fin count. I have too little experience of the Mahseers of South India to generalise, although I have had a certain number of them in my hands.

It is, perhaps, natural that the available descriptions should make much of the Mahseer's colouration. It certainly is very striking, but it must be confessed that it varies very considerably. Moreover, the colours of the living fish change rapidly after death, the reddish tones strengthening, while the jade green and blue tones pale to brown and slate. Thomas, with the living fish in front of him, describes the dominant Bawanny Mahseer as worthy of its name, Bom-Min, the gold fish. He says that its colour is not really gold-fish-like but 'something between the colour of a bright new sovereign and that of bright, shining copper fresh from the mint, the burnished copper the colour of the outside of each scale, and the tinge of brighter gold flashing through the centre of each scale and coming out almost all over the gill covers and showing freely in parts of each fin'. He specifically says that this is the 'predominant colour of every scale'. I have seen these golden Mahseer in the Bawanny and accept Thomas' description. I have, also, seen his second type of Mahseer 'with grey back, silver stomach and bright orange fins and tail'. But I have never been fortunate enough to catch his third, with 'deep chocolate coloured back and fins, the colour blending into golden brown on the sides and gills and fading into white on the stomach' the eye being vermillion. 'Skene Dhu' quotes three Mahseers :—(1) the Punjab Mahseer which he describes as 'silvery with scales becoming golden below the lateral line and fins reddish', (2) 'The Mahseer of the Narbudda (in which river No. (1) is also to be caught)—Pale Blue', and (3) the jet black Mahseer of the Kalinadi River, which he also reports from the Punjab. His pale blue Mahseer from the Narbudda is common enough; I have, also, caught these fish at Rupar on the Sutlej. I have never seen a black Mahseer, though I have caught many that were either deep jade green or dark slate, and I have noticed that the green body colour usually goes with gold-red fins, the others having pinkish fins which rapidly redden after death.

Dr. Hora states categorically that the colouration of *Barbus* (*tor*) *putitora* 'varies considerably with the type of waters inhabited by it'. I think that this warning should be applied to all Mahseer species as, indeed, it does to trout and many other genera and species of fish. The most extreme example of colour variation I have found among Mahseer was a female fish of 27 lbs., which I caught in the Swat River, in the sandy pool above the head-works of the Upper Swat Canal. It was an opaque white, exactly the colour of the river bed. This was an old fish, which may account for the want of silvery tones, but the conformity with the background was most striking. Fish of this size are not washed over the dams even in floods, and as I have never seen the fish-ladder at this particular head-works used, upwards or downwards, I am inclined to think this fish had inhabited the pool for some considerable time.

With regard to the precise identification of the Mahseer species of the rivers of North India, any fisherman with sufficient experience will, I think, agree as to the existence of the two acknowledged species, *Barbus* (*tor*) *putitora*, and *Barbus* (*tor*), Tor of Hamilton. The former is a long, racy fish, with a big mouth and a long head; the latter a shorter, heavier fish, with a smaller mouth and a shorter head. On the other hand, I admit that I cannot distinguish Hamilton's *Barbus* (*tor*) moral from his putitora. As I have said, I feel that until a larger number of living fish have been described, little weight should be given to differences of colouration in distinguishing Mahseer species as a whole. My first impression is that the Mahseer of the Kurram, Ghorband and Kunhar Rivers are of the Putitor type. But this does not amount to more than my second impression, that the Putitor inhabits faster water than the Tor Mahseer, and is therefore found higher up the rivers.

6. *Sex and Size.*

Dr. Hora (*Journ.,B.N.H.S.*, Vol. xli, pp. 278 *et seq.*) admits that the formation of the lips of the *Barbus* (*tor*) *putitora* varies considerably, and says that this wide variation is common to the Mahseer species of India, as well as to 'the large scaled Barbel of the neighbouring countries and Africa'. Thomas rightly observes that it is found in small immature Mahseer and rebuts the almost universal opinion of Indian fishermen that the Mahseer with hypertrophied lips are females. Ghulam Muhammad, the chief shikari of Tangrot, is the only Indian fisherman I have ever met who knew this to be false. My own observation of sex differentiation are limited, but my experience indicates that the females greatly exceed males in number. I have only found three male Mahseer. All these were well under 7 lb. and were long, thin fish, noticeably less in girth than the females from the same waters. I am convinced that the bulk of large Mahseer of over 20 lbs. are female. I can find only one case of an alleged large cock fish in the Tangrot Fisherman's Books. This weighed 53 lbs. and was caught in the Jungoo Pool; no details of the dissection are given, and knowing the difficulties of field dissection, the entry may be considered dubious. I must, incidentally, record that I have never caught a Mahseer with hypertrophied lips of over 15 lbs.

I have never preserved, or attempted to analyse, the scales of the fish I have caught. But, as I have already suggested, there is a great difference between the lustre of the average fish between three and twenty pounds and large fish of over twenty-five pounds. Most fish of over twenty-five pounds suggest senility, rather than maturity, and this is clearly indicated by the size and condition of the female organs.

It is possible to get a fairly accurate idea of the range of size of the living Mahseer, by climbing the hill above the Jungoo pool at Tangrot. In November and December, the head of the great pool is thick with fish, lying head to tail. Immediately below the neck of the pool, where the warm springs are, lie the monsters. There are usually four or five fish of well over sixty pounds. At that time, the water is crystal clear and at midday every movement of tail and fins can be seen from above. The monsters hardly stir. Then come, rank after rank, the lesser fish. Occasionally a small fish noses its way into the high places of the great, only to scurry to the safer shallows at the first movement of a fin. At the tail of the pool, fish of up to 10 lbs cruise about, the smaller ones obviously feeding on the bottom or among the mixed fry near the banks. It is interesting to notice that several fish of fifty two or three pounds have been caught at Tangrot, but none bigger. The monsters of Jungoo do not take any known bait, and the fact that even live bait will not move them, suggests that in old age the Mahseer becomes wholly a bottom-feeder. I have often noticed how bad the throat-teeth of the average Mahseer of over ten pounds are, though this is probably not the reason why they turn away from the cannable delights of their maturity. There are many pools such as Jungoo is, throughout the length and breadth of India. I have watched the fish in them for hours throughout daylight, but I have never seen the really big fish feed.

The infantile Mahseer, like the mature Mahseer, is omnivorous. But they have their seasons and close-seasons. In October in the Chiblat River at Hassan Abdal, the weed grows thick and luscious, and the Mahseer, also, grow fat on it, refusing all other bait, except a live frog, the one bait which may tempt Mahseer at all times of the year. I have, also, noticed that the stomachs of the fresh run fish, arriving in Jungoo from upstream after the autumn downward migration, are usually empty except for masses of convervae. But they will take minnow, live, dead or artificial, if it is offered to them sufficiently skilfully. The explanation seems to be that they are too tired for the first few days to face the rapids, near the banks of which the fry and small fish nervously hide. Fry are on the whole strikingly absent from such pools as Jungoo and in September-October there is nothing much else edible in them, except convervae. A few days later the fish move out into the rapids, and the Fisherman's Books and all who know Tangrot, agree that October is the river's best month, challenged only by March. On the other hand it is hard to believe that the monsters live only on convervae. Molluscs are not universally distributed in such pools, or indeed, in any Indian river. I am inclined to think that worms form a larger part of the Mahseer diet than is usually admitted. I, also, have incontestable evidence that he does not spurn the dropping of the herds that go down to drink in the evening.

The Tangrot Fisherman's Books are full of references to 'the Chilwa running' and laments of 'no Chilwa'. I have never caught or seen *Chela argentea* in the Jhelum or Poonch. There are plenty of silvery Tengra (*Macrones seengala*) though they seem to run rather small; at least, I have never caught one of over 2 lbs. At the head of Jungoo, there are, also, usually one or two large *Wallago attu*. There are, also, a few Kalabans (*Labeo calabasu*). Unlike the Tengra the Labeos are unprotected by spines, and they have no teeth like the fresh-water shark; it is evident that the Mahseer rules the roost in the lower Poonch and Jhelum. The population pressure is set up by the Mahseer, itself, and, since he is essentially a cannibal, he probably also is its most important limitting agent.

If the opportunity ever comes my way again, I shall certainly devote as much time as possible to taking the census of pools like Jungoo. As everywhere, it is certain that the size and numbers of the fish are directly governed by the size of the waters and the richness of the feeding grounds. A big fish from the Chiblat would be inconsiderable by Tangrot standards. Moreover, all these Indian rivers have suffered at the hands of man. They have all, at times, been dynamited and are all netted and long-lined in spite of regulations and paid watchers. At Tangrot the recorded weights of fish caught do not provide a smooth curve. Fish up to 15 lbs. are frequent and those of 25 lbs. are not infrequent. Moreover, fish of over 35 lbs. are surprisingly common. But in between there seems to be a gap. My own records and observations of the population of Jungoo agree with this, though I cannot account for it. It would be interesting to find out if the larger Jhelum fish migrate upstream to the Woolar Lake, a gruelling journey which would cause heavy casualties. It is possible that the monsters spawn in the lower tributaries of the Poonch, each having its fixed territory, so obviating the dangerous struggle upstream. I have never seen very large fish at the Jhelum fish-jumps during the actual migration, though it is common knowledge that fish of over 50 lbs. are to be caught at Ningle in August.

A NOTE ON SOME SNAKES OF BENARES (U.P.)[1]

BY

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The 'Kaiser Castle'[2] at Benares, which at present houses the office and collections of the Zoological Survey of India, consists of blocks of buildings in a large compound situated on the bank of the Varuna river. Specimens of snakes occasionally found in the compound or inside the rooms of the 'Kaiser Castle' have been collected by some members of the staff during the last three years. The collection at present consists of 17 specimens belonging to 5 species.

The collection at my disposal is far too small to give any idea of the number of species of snakes occurring in and around Benares, but as practically nothing is known of the snake fauna of this area, a record of the species already collected will, it is hoped, prove useful. Except for one paper by Wall[3] on the snakes of the Fyzabad district, I am not aware of any works dealing with the reptilian fauna of the United Provinces specially. During the course of 19 months active collection at Fyzabad, Wall was able to collect 704 specimens referable to 18 different species.

Fauna as a whole in Benares is very poor. Nevill[4] has remarked: 'The density of population, the high state of agricultural development and the absence of forests or extensive jungles combine to render Benares one of the poorest districts in the matter of wild animals of all those that are comprised in United Provinces.'

I am grateful to Dr. B. N. Chopra, Director, Zoological Survey of India, for going through the manuscript and making some helpful suggestions, which, I feel, have materially improved this note. I am also thankful to those members of the staff of the Zoological Survey, who have collected the specimens on which this note is based.

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[1] Published with the permission of the Director, Zoological Survey of India.

[2] Named after the owner H. E. Sir Kaiser Shumshere Jung Bahadur, Rana of Nepal.

[3] Wall, F., *Journ., Bombay Nat. Hist. Soc.*, xviii, pp. 101-129 (1907).

[4] Nevill, H. R., *Gazetteer of Benares*, xxvi, pp. 17-18 (1909).

The following 5 species are represented in the collection:

FAMILY: COLUBRIDAE.

1. *Ptyas mucosus* (Linn.): 8 specimens; collected in March, July, September, October and November.
2. *Oligodon arnensis* (Shaw): 2 specimens; collected in March, and April.
3. *Lycodon a. aulicus* (Linn.): 4 specimens; collected in June, July and September.
4. *Natrix piscator* (Schneider): 1 specimen; collected in June.

FAMILY ELAPIDAE.

5. *Naja n. naja* (Linn.): 2 specimens; collected in April and June.

Ptyas mucosus (Linn.)

(The Rat Snake or Dhaman)

1758. *Coluber mucosus*, Linn, *Syst. Nat., Ed.* 10, p. 226.
1864. *Pyas mucosus*, Gunther, *Rept. Brit. India*, p. 249.
1943. *Ptyas mucosus*, Smith, *Fauna Brit. India.* (Reptilia & Amphibia), iii, p. 159.

There are 8 specimens in the collection, varying in length between 413-1670 mm.

Wall (*loc. cit.*, 1907, p. 114) has remarked on the variation in the range of ventrals and subcaudals in this species and has pointed out that in the Fyzabad specimens there is a tendency for the subcaudals to be fewer in number than in the examples he had previously examined from Cannanore. The same is also observed in the 8 specimens from Benares that I have examined, as is seen in the accompanying table.

Comparative Table of Scale Counts.

	Ventrals			Subcaudals
Fyzabad collection	(8) [1]	♂	192–207	100–126
	(8)	♀	191–206	108–115
Benares „	(8)		192–209	102–124
Cannanore „	(4)	♂	197–202	127–137
	(3)	♀	192–196	128–132

According to Smith the range in the number of the ventrals and the subcaudals is as follows:

Ventrals 190-213; Subcaudals 100-146. Wall and Pope[2] have stated that the males are greater in length than the females.

Ptyas mucosus is found throughout India and Indo-China. It has also been recorded from Java and Sumatra.

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[1] The figures in parentheses show the number of specimens on which the scale counts are based.

[2] Pope, C. H., *The Reptiles of China*, x, p. 221 (1935).

Oligodon arnensis (Shaw)

(The Common Kurki Snake.)

1802. *Coluber arnensis*, Shaw, *Gen. Zool.* iii, p. 526 (based on Russell's fig. 38).

1890. *Simotes arnensis*, Boulenger, *Fauna Brit. India.* (Rept. & Batrachia), p. 314.

1943. *Oligodon arnensis*, Smith, *Fauna Brit. India.* (Rept. & Amphibia), iii, p. 225.

Oligodon arnensis is represented in the collection by two juvenile specimens, measuring 185 and 175 mm. respectively.

The larger specimen has 32 black bars on the body and 12 on the tail, while the smaller one has 34 bars on the body and 10 on the tail. The broadest black bars occupy 3 scales. They are narrower on the sides, have white margins and do not reach the ventrals.

Wall[1] has noted that specimens from the United Provinces, Punjab, N.W. Frontier and Western Himalayas have 41-54 black bars on the body and 9-12 on the tail, while one specimen from Orissa had 37 bars on the body and 6 on the tail.

Smith after examining a series of specimens from different localities came to the conclusion that the number of black bars on the body and the tail is roughly correlated with the geographical distribution of the species. He arranged them as follows:

Ceylon, 13-18 on the body, 3-6 on the tail.
India, South of lat. 20° 18-30 on the body, 4-16 on the tail.
India, North of lat. 20° 7-20 on the body, 7-20 on the tail.

In both the specimens from Benares the loreal scale is present. According to Smith this scale is usually present in specimens north of lat. 20°, but absent in examples south of that line. Wall (*loc. cit.*, 1914, p. 755) has also remarked that the loreal is rarely absent in examples from Fyzabad.

Oligodon arnensis is very widely distributed, and is one of the common forms found in the United Provinces. According to Smith 'Its habits are chiefly diurnal, and it appears to make its home for the most part in masonry, domiciling itself in bungalows and out-houses'.

Lycodon aulicus aulicus (Linn.)

(The Common Wolf Snake.)

1758. *Coluber aulicus*, Linn., *Syst. Nat.*, 10th Ed., p. 220.

1870. *Lycodon aulicus*, Stoliczka, *Journ., Asiat. Soc. Bengal*, xxxix, p. 201.

1943. *Lycodon a. aulicus*. Smith, *Fauna Brit. India* (Rept. & Amph.), iii, p. 265.

There are four examples of *Lycodon a. aulicus* in the collection varying in total length between 450-540 mm. Wall[2] gives the total length of the largest male and female of this species, so far recorded, as 692 and 737 mm. respectively.

In every specimen there are 8 upper labials, of which the 3rd, 4th and 5th, touch the eye. There is absence of brown spots on the upper labials of one specimen (collected in Sept. 1942), while the rest have faint brown spots.

In all the 35 examples in the Fyzabad collection examined by Wall (*loc. cit.*, 1907, p. 113), the anal scale was found to be divided. In my collection from Benares there is one specimen in which this scale is entire. This aberration has been recorded by Smith (*loc. cit.*, 1943, p. 255) in several species of *Lycodon*, such as *aulicus, striatus*, and *travancoricus*.

The colouration of all the four specimens is of the same type, but the number of cross bars on the dorsal surface varies considerably. One example has 19 cross bars, one 15, one 18 and the remaining one 10. In every case these bars are whitish with faint brown spots.

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[1] Wall, F., *Journ., Bombay Nat. Hist. Soc.*, xxii, p. 751 (1914).

[2] Wall, F., *Ophidia Taprobanica*, p. 159 (1921).

Smith[1] has described the arboreal habit of *Lycodon aulicus*, stating 'It is a good climber and appears to prefer the roof to the floor'.

Natrix piscator piscator (Schneider.)

(The Chequered Water Snake.)

1799. *Hydrus piscator*, Schneider, *Hist. Amph.*, i, p. 247.
1940. *Natrix p. piscator*, Smith, *Rec. Ind. Mus.*, xlii, p. 483.
1943. *Natrix p. piscator*, Smith, *Fauna Brit. India* (Rept. & Amph.), iii, p. 295.

Four fairly well defined races of this species are recognizable, dependent chiefly on the colour pattern and geographical distribution.

According to Smith the following races are found in India:

1. *Natrix piscator piscator.*
2. *Natrix piscator flavipunctata.*
3. *Natrix piscator asperrimus.*
4. *Natrix piscator melanzostus.*

There are blackish spots on the dorsal surface giving off a bluish sheen. The spots are arranged in a 'Chess-board pattern'. The under-surface is whitish. The scale counts and the length of the single specimen in my collection are given below:

Scale counts: Mid-body 19; Ventrals 138; Caudals 78.

Total length: 976 mm. Tail 269 mm.

Natrix piscator chiefly feeds on frogs and fish. It causes great destruction to fish, when they are herded into shallow water at the end of the dry season.

Naja naja naja (Linn.)

(The Indian Cobra.)

1758. *Coluber naja*, Linn., *Syst. Nat.*, 10th Ed., p. 221.
1943. *Naja n. naja*, Smith, *Fauna Brit. India* (Rept. & Amph.), iii, p. 431.

The most striking point of interest in the present species is the variation in the colour scheme and in the markings of the hood. Smith on the basis of the 'hood design' divided 'Indian cobras' (*Naja naja*) in three races, which can be correlated to some extent with geographical distribution also. Bannerman & Pocha[2], after examining a series of specimens, had come to the same conclusion many years earlier. Wall found 12 different designs or patterns of the hood markings in his 39 examples from Fyzabad.[3] Out of the two specimens under report, the hood markings are distinct in one and tally with the markings shown by Wall on Plate I, fig. 4. In the second example the markings are interrupted and broken on the sides.

The colouration is brown in one specimen and blackish brown in the other. The total length of the specimens is 870 and 780 mm. respectively.

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[1] Smith, M.A., *Journ., Nat. Hist. Soc., Siam*, i, p. 16 (1914).

[2] Bannerman, W. B. & Pocha, J. B., *Journ., Bombay Nat. Hist. Soc.*, xvi, p. 638 (1905).

[3] There are beautiful plates in black-and-white drawn by Wall (*Journ., Bombay Nat. Hist. Soc.*, xviii, pl. I & II, 1907) showing different hood patterns found in Fyzabad specimens.

THE HEMIPENIS IN REPTILES.

BY

CHARLES MCCANN, F.L.S.

(*With* 10 *plates and* 4 *text-figures.*)

INTRODUCTION.

On going through the *Fauna of British India* (23) (Reptilia), 2nd ed., vol. iii (Snakes), we find several descriptions and seven illustrations of the hemipenes of snakes. These descriptions and illustrations have been largely based on material dissected out of spirit specimens, and, consequently merely give a picture of the organs in a quiescent state, retracted into the base of the tail. Such descriptions and illustrations, though valuable in themselves, can give no idea of the organs in the everted condition, which is perhaps the truer aspect. The study of the everted organ may possibly throw some light on the habits, anatomy, and other features of the various species. It is already well-known that there is a considerable variation in the structure of the hemipenis from genus to genus, and in some instances from species to species. Although some herpetologists have attempted a classification based mainly on the morphology of these structures, there appears to be plenty of room for further investigation based on especially collected material.

Col. Frank Wall (13), that indefatigable field-worker on Indian snakes, was apparently the first to draw attention to the subject of the possibility of a classification based on the structure of the hemipenis. In 1923 when reviewing the genus *Oligodon* in the *Records of the Indian Museum,* Wall wrote:

> ‘A study of the genitalia shows that there are very different varieties to be met with among the species, and it is possible the genus, as now represented, may be divided hereafter on this basis.

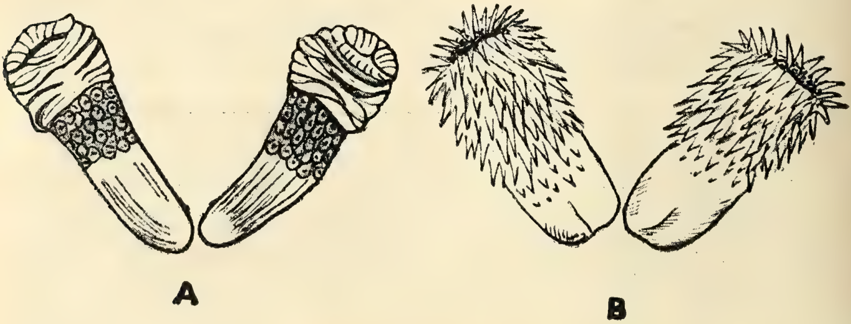


Fig. 1, Hemipenes of A. *Oligodon albocinctus;* B. *O. sublineatus* (after Wall.)

> ‘However I have the genitalia of only four species, it is wisest provisionally to let them all remain under the one generic title Oligodon.’ (*l.c.*, p. 305.)

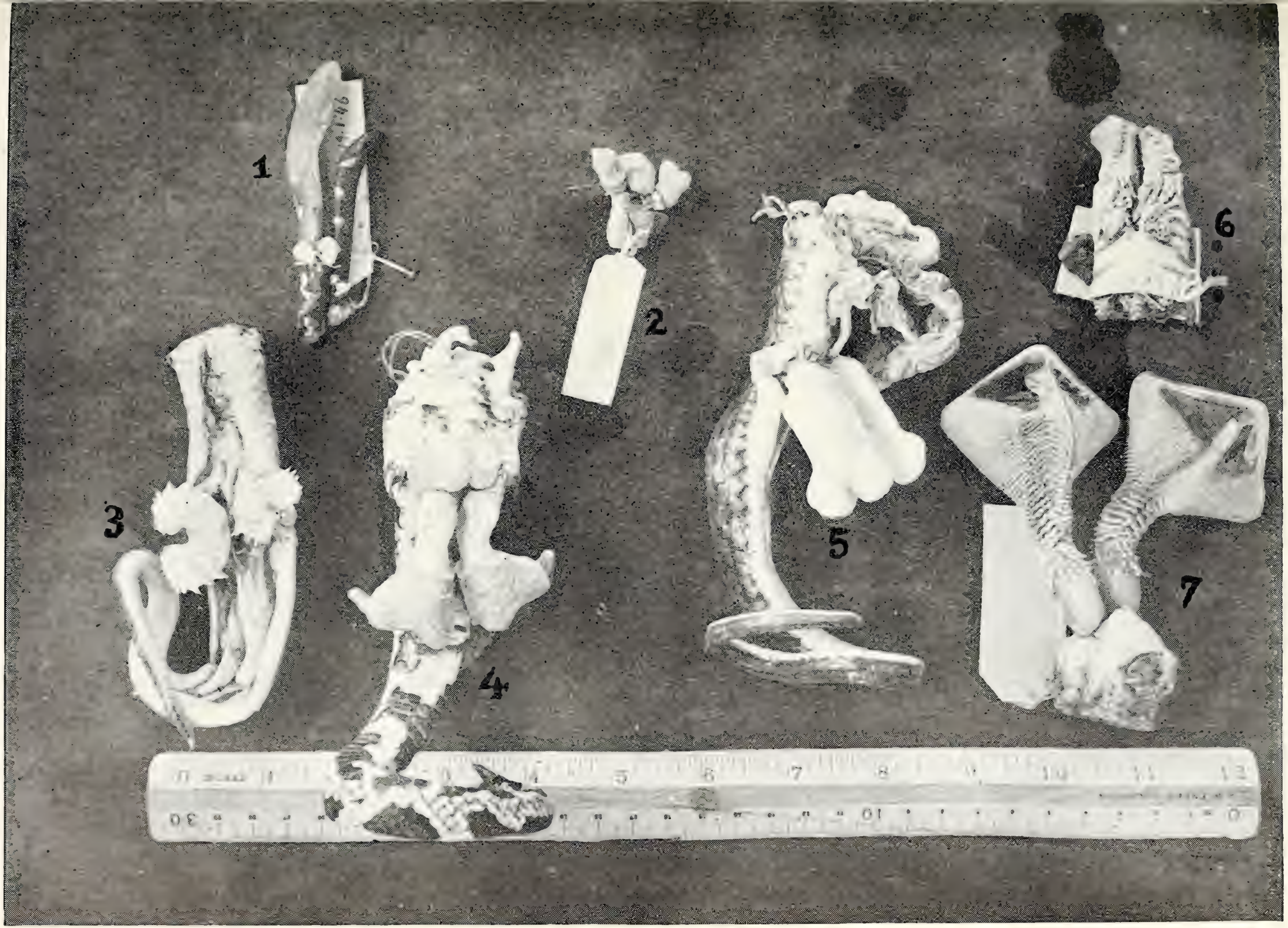


PHOTO: C. McCANN.

Hemipenes of Snakes.

1. *Hydrophis cyanocinctus* (Daudin); 2. *Bungarus cæruleus* (Schnd.); 3. *Vipera russelli* (Shaw); 4. *Python molurus* (Linn.); 5. *Natrix piscator* (Schnd.); 6. *Pytas mucosus* Günther, (partially protruded); 7. *P. mucosus* (fully everted).

> 'The male genitalia vary in the species here included in one genus, and it is possible that this variation may be used as a basis for a subdivision of the genus into two. I have dried genitalia of four species in my collection. In *taeniolatus* and *sublineatus* the organ is relatively small, cylindrical and beset with recurved cartilaginous processes from base to extremity, just as one sees in so many other species of the *Colubridae*. In *albocinctus* and *juglandifer*, however, the organ is relatively very large, cylindrical, and increases in girth from base to extremity, being cleft at the extreme tip. There are no recurved processes. The proximal third has feeble longitudinal rugae, the middle third a honey-comb network, and the distal third concentric and somewhat imbricate rugae (see figures)' (*l.c.*, p. 306.)

Although Wall saw the possibility of a classification of snakes based on the structure of the hemipenis, he evidently did not persue the subject further for I can find nothing more from his pen relative to it. Wall had only dried genitalia of four species and describes 'two forms' in his paper referred to above. The illustrations of the two types, fig. 1, show clearly the differences, although the organs are not fully everted. Here we must leave Col. Wall and pass on to a decade later.

In 1933 C. H. and S. H. Pope (17), undertook a study of the Asiatic and Malasian Green Pit-Vipers identified under the name *Trimeresurus gramineus* and published their results in the *American Museum Novitates*. Their investigations were based entirely (?) on preserved material dissected out from specimens in the collections of the British Museum (Natural History) and those in the American Museum of Natural History. The results indicate that:

> 'A study of the hemipenis of nearly every valid species of *Trimeresurus* has convinced us that this genus may be divided into groups of allied forms having different types of hemipenes.' (*l.c.*, p. 1.)

The authors were conscious of the possibilities arising out of this method of classification for they asked the question:

> '. . . is the hemipenis more or less stable than the various external characters generally relied upon for the determination of the species and even genera? Also, is it more valuable for the separation of large or small groups, in the classification of snakes? In the genus *Trimeresurus*, the hemipenis is excellent for the separation of the various species into groups, but we think it would be dangerous to generalize until more detailed data on this organ in other genera are available.' (*l.c.*, p. 3.)

However, a serious difficulty with this form of classification is undoubtedly the determination of the females. The authors, quoted above, refer to this aspect in their conclusion which reads:

> 'The females of *T. gramineus* and *T. stejnegeri* cannot be distinguished from each other with certainty, while mature males are recognised at once by the form of the hemipenis. Immature males generally may be separated by colour characters. The meaning of this similarity in two form with radically different hemipenes is not understood but may be correlated with ecological adaptations therefore field studies are much needed.' (*l.c.*, p. 12.)

The frequent handling and observing of living snakes and lizards first drew my attention to the subject of the hemipenis on account of the frequent eversion of the organ when handled. This behaviour led me to consider the subject of copulation in many of its aspects in these two groups of reptiles. With a view to understand the true characters and function of the organ, I adopted a simple process of everting the organ when in the fresh condition, and of fixing it in the everted condition in preservation. This method, which I shall explain below, can only be applied to fresh material, i.e. recently killed animals. The photographs and diagrams will fully illustrate the points I have raised. Before proceeding, however, it is necessary to give a brief explanation of the structure of the organ without delving too deeply into its anatomical details and myology, and to refer to the postures assumed during coitus, which, I am of opinion, have a very significant bearing on the subject. Unfortunately, I have very little literature at my disposal and must therefore rely largely on my own observations.

A discussion on the structure of the hemipenis in snakes and lizards would perhaps be incomplete without reviewing the structure of the male genitalia throughout the Order. Accordingly, I will discuss the structure of the corresponding organs of crocodiles and chelonians by way of comparison.

STRUCTURE OF THE HEMIPENIS.

To start with, allow me to quote the definitions given in some of the standard text-books:

Parker & Haswell (7): 'A pair of vascular eversible *copulatory sacs* which when everted are seen to be of cylindrical form with a dilated and bifid apex, open into the posterior part of the cloaca.'

Sedgwick (4): 'There are two penes. They have the form of eversible hollow sacs opening into the posterior wall of the cloaca and attached by a retractor muscle, passing from the hinder end, to some of the caudal vertebrae. A groove runs to them from the opening of the vas deferens for the conveyance of the sperm. Erectile tissue is found in their walls. The organs can be everted through the anus and used as copulatory organs. They are present in both sexes, though less developed in the female.'

Smith (23): '. . . have paired copulatory organs. . . . Each organ consists of a tube of erectile tissue, which can be everted like the finger of a glove. . . . They are flattened on their inner sides, more rounded externally.' (*l.c.* p. 10.)

The above statements are but general descriptions which give us very little idea of the true structure and appearance of the organ, and therefore, need a certain amount of explanation to ensure clarity, as the characters vary much from the quiescent to the active condition.

Gadow's (3) descriptions of the organs in the various groups are in more detail; they read as follows:

Lizards: 'The cloaca of Sauria is somewhat modified; instead of the Coprodaeum, Urodaeum, and Proctodaeum forming three successive chambers, the urodaeum is practically reduced to its dorsal half, forming a dorsal recess between the two chambers. The Coprodaeum is restricted into several successive chambers, and is always well shut off from the urodaeum by a strong sphincter. The urodaeum receives the urinary secretions, which are mostly chalky white and are rather consistant instead of being fluid. The right and left oviducts also open into it. The vas deferentia open into the dorso-lateral portions of the walls of the urodaeum, but the sperma is conducted by folds in the lining of the chamber towards the base of the copulatory organs, which, although arising from the lateral and posterior corners of the cloaca, where uro- and procto-daeum meet, are stowed away outside the cloaca. These organs are always paired. The proctodaeum or outermost cloacal chamber is shallow. Its inner opening is round and is furnished with a strong sphincter, but it is surrounded and covered by lips of the outer skin, which forms a transverse slit. This is due to the peculiar arrangement of the copulatory organs.

Each organ consists of a tube of erectile tissue, and can be everted like the finger of a glove. To the apex of the tube is attached a long retractor muscle, which arises from the ventro-lateral surfaces of the caudal vertebrae and extends a considerable distance back. When at rest and withdrawn the organs form conical, longitudinal swellings on each side of the root of the tail, an external feature by which male specimens can generally be distinguished. Only one organ is inserted at one time.' (pp. 498-499.)

Snakes: 'The cloacal arrangement is essentially the same as that of the Lacertilia, but snakes possess no urinary bladder. The copulatory organs are stowed away beneath the skin in recesses of the posterior lateral corners of the shallow cloacal vestibulum. Each organ is usually bifurcated at the free end, and furnished with little spike-shaped, but scarcely horny, excrescences. On each side of the outer cloacal chamber, in both sexes, lies a roundish gland with an offensive, strongly-scented secretion; that of various Boas smells disagreeably sweet and musky.' (p. 585.)

T. Rymer Jones's (1) remarks on the structure of the hemipenis are of special interest, they are as follows:

'(2025.) . . . The earliest appearance of the copulatory organs is seen in Serpentes and in the Lizard tribes; and in such reptiles it will be observed that the penis is rather a provision for securing the juxtaposition of the sexual aperatures of the male and female than an instrument of intromission. The two lateral halves of the penis (or *corpora cavernosa*, as we shall have to call them hereafter, when they become conjointed in the mesial line) are as yet quite separate, and palced at each side of the cloaca fissure, from which they protrude when in a state of erection, so that there appear to be two distinct organs of excitement, or, more properly speaking, of prehension: for each division, being of course imperforate, is covered with sharp spines, and is obviously rather adapted to take firm hold of the cloaca of the female than to form a channel for the introduction of the seminal fluid.' (*l.c.*, p. 758.)

The organ is paired. When at rest the two halves are retracted *outside in* into the base of the tail. On dissection of the tail the operator *only* sees the *inner* surface of the organ. In this position it appears like two subcylindric, linear, muscle processes lying adjacent to one another. The organ is scarcely separable from the retractor muscle itself, except for a slight difference in colour, and texture on palpation. The retractor muscles extend the whole length of the tail. Nothing of the formation of the sculpturing is visible. On opening one of these bodies the operator sees what would be presented externally in the everted condition, but much shrunken and distorted, and therefore, he does not get a true picture of the external morphology of the organ. From this aspect of the organ we must pass to the everted aspect to understand its characteristics. As the two halves are exactly alike a description of one half will suffice.

Broadly speaking, half the organ, when everted, presents the shape of a flower bud with a short or long stalk. To facilitate description I shall refer to the stalk as the *pedicil* and the 'bud' as the *head*. The division between the pedicil and the head may be well demarcated or barely so. The pedicil may be strongly or feebly armed with spines or excrescences of varying size and shape, or with fleshy transverse collars, flounces or ridges. Likewise the surface of the head may be beset with similar structures; or, both regions may be smooth or with just a few fissures or furrows. The head may also possess horn-like appendages. On the inner face (the side facing the central long axis of the body) there is a deep or shallow groove. This groove, known as the *sulcus,* may be clearly visible up the entire length of the organ or it may be less pronounced in the region of the head itself. This groove is in direct communication with the opening of the ureter, and acts as a channel for the conveyance of the spermatic fluid. (A few ridges run from the base of the opening of the ureter to the base of the sulcus.)

The bulk of the tissue composing the organ is erectile tissue, and when everted the organ is hollow within, except for the muscle strands drawn up from the retractor muscle and the semi-cartilaginous 'ribs' supporting it which are only visible in certain species. I shall refer to these structures under the specific heads of the species I have so far examined. The position of the organ at rest is often visible externally. It is represented by a thickened area just below the vent, but certainly does not always form an infallible distinguishing character between the sexes without further investigation. In practiced hands an animal can, many a time, be made to evert the hemipenis on pressure at a point a short way below the vent. It may evert only one or both halves simultaneously. To attain the extrusion of both halves together (which is sometimes possible) pressure must be exerted at a particular point. This must be located by practice. Merely lifting up an animal by its tail may occasionally produce the same result.

On going through the *Fauna* (23) we find the statement: 'In pairing, only one organ is everted at a time, but which one is immaterial, and depends upon the side the male happens to be at the time of copulation.' Gadow (3) makes a similar statement. On what grounds the "observation" or "conclusion" rests I am unable to say, but it certainly gives rise to much room for doubt when we consider the structure and behaviour of the hemipenis in the living animal. A significant point is the posture assumed during coitus. There is hardly any possibility, if at all, of observing the insertion or extraction of the organ for:

(*a*) the organ is only everted when the two vents are approximated;

(*b*) the organ is collapsed soon after the emission of the seminal fluid and the cessation of sexual excitement, and accordingly it is retracted at the time when the two vents separate.

With these two serious difficulties in view, actual observation is almost, if not entirely, impossible. I have frequently observed lizards in coitus, but have never been able to establish whether one or both halves of the organ are inserted for the reasons stated above. Even if a pair of lizards or snakes in coitus were killed instantaneously, the killing of the animals would result in the immediate cessation of sexual excitement, and would probably be followed by the partial or complete collapse of the hemipenis.

Again, under normal circumstances there is the possibility that one hemipenis may retract completely in advance of the other, and the partially retracted one may be 'trailed' in a flaccid condition for a while outside the vent. Such a 'trailing' of the penis after coitus is not infrequently observed among anserine birds. Injury to the organ during coitus may also result in belated retraction. This last point I have occasionally observed in *Calotes*. Perhaps the accidental extrusion of the hemipenis on such an occasion may have given rise to the statement quoted above.

Testudines.

Testudines.—The formation of the penis in tortoises and turtles has been described in the *Fauna* (15) along with that of crocodiles. It reads as follows:

> 'In crocodilians and chelonians a median unpaired penis arises from the ventral wall of the proctodaeum and is extruded through the anterior end of the cloacal slit. On its dorsal surface there is a deep groove which leads back to the openings of the seminal ducts.' (*l.c.*, p. 29)

On p. 54 there is a little more detail:

> 'The cloaca is large and its divisions are imperfectly defined. The proctodaeum contains the unpaired copulatory organ, which is deeply grooved on its dorsal surface and is constructed much like that of the Crocodilia. The coprodaeum and urodaeum are confluent, and into them open the genital ducts, the bladder and the end of the gut, the termination of the latter being well marked.'

[1] T. Rymer Jones (1), writes:

> '(2026.) In Chelonian reptiles the penis is much more perfectly developed, and really constitutes a very efficient intromittent instrument. The two corpora cavernosa, after commencing separately, approach each other, and become united along the mesial line so as to form a single organ of considerable size, terminated at its extremity by a glans-like dilatation. There is, however, no *corpus spongiosum,* nor urethral canal properly so called; the latter is represented by a deep groove which runs along the upper surface of the penis from the cloaca to the extremity of the organ; and it is along this groove that the spermatic fluid is conveyed during coitus.' (*l.c.*, p. 758.)

So far I have not had the opportunity of examining the genitalia of a freshly killed male specimen.

Crocodilia.

The description of the penis cannot be dismissed in general terms in the *Crocodilia* as it is rather a complex structure. This statement is all the more forcible when it is viewed from the aspects of comparative anatomy and field observations. Gadow (3) describes it in the following terms:

> 'In the latter (proctodaeum) is stowed away the large copulatory organ. It arises out of the medio-ventral wall of the cloaca, and has a deep, longitudinal groove on its morphologically dorsal side for the conduction of the sperma, the vas deferentia opening near its basal end. On either side of the root of this organ, in both sexes alike, opens a peritonial canal, wide enough in large specimens to pass a goose-quill. The outer opening of the cloaca forms a longitudinal slit: within it dorso-laterally, are the openings of the two anal musk glands.'

The *Fauna* (15) states:

> 'On its dorsal surface there is a deep groove which leads back to the openings of the seminal ducts.'

[1] T. Rymer Jones (1), writes:

> '(2029.) In the Crocodiles and higher Saurians the penis in its structure resembles that of the tortoise; and instead of a urethra, there is merely a deep groove traversing the upper surface of the organ, along which the semen trickles out of the cloaca.' (*l.c.,* p. 758.)

To the field-worker the position of the sulcus offers some difficulties which I shall indicate below, after describing the organ. For the purpose of clarity I shall refer to it (the sulcus) as being ventrally situated.

Crocodilus palustris Lesson. (Pl. III & Pl. V) & Text-fig. 2.

The penis is composed of solid fibrous tissue and consequently cannot alter its size and shape when under the stimulus of sexual excitement. The ridgity of the organ, however, is compensated for by the presence of erectile tissue at its base which is capable of altering the position of the penis from the retracted, resting position to the protruded active posture. The erectile tissue merely acts as a hinge. At rest the organ is reverted into the cloacal lit., i.e. it is retracted backwards bringing the sulcus nearest the vertebral column and the extremity pointing backwards towards the tip of the tail. When erected the position of the organ is reversed, the distal end pointing foreward. In this position the sulcus is brought below (and is 'ventral'). It is this change in the position of the sulcus that confounds the field-worker. Viewed

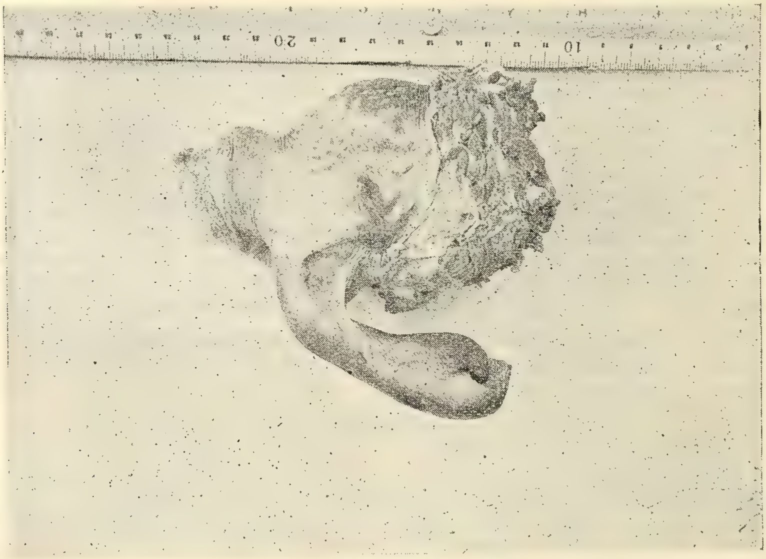


Fig. 2

Copulatory organ of *Crocodilus palustris* Lesson.

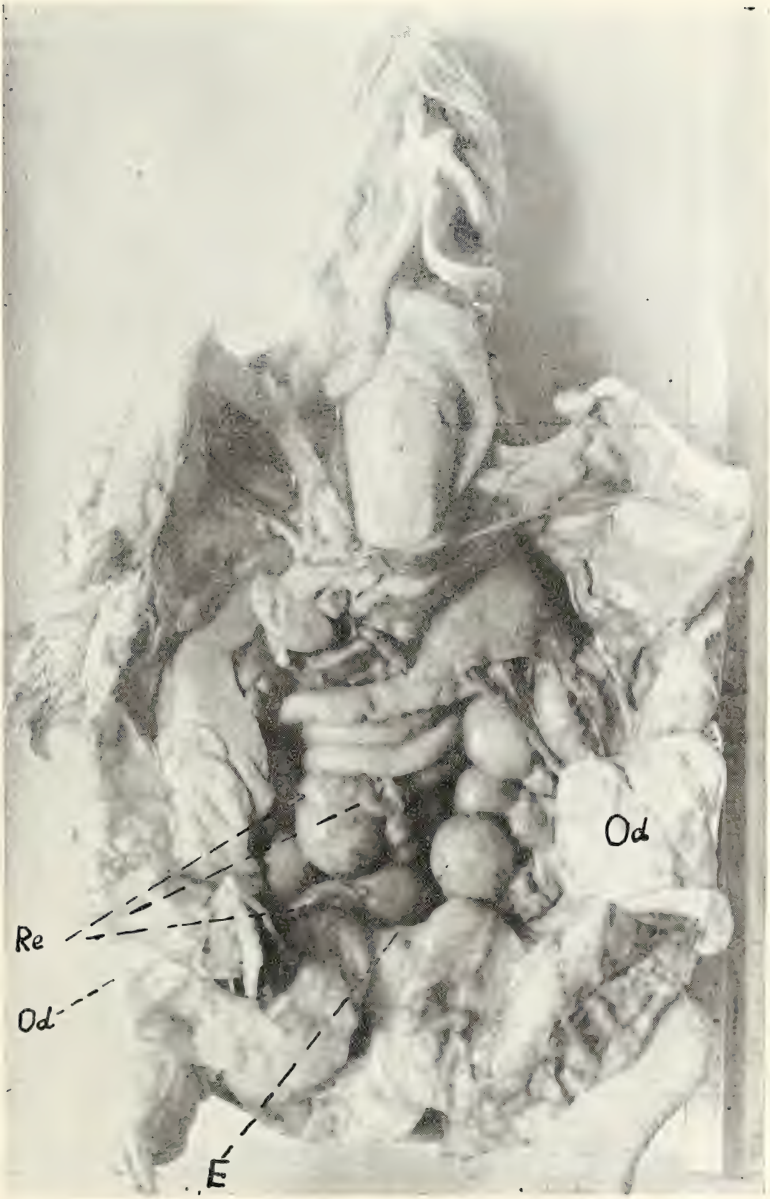


Photo: C. McCann.

Lissemys punctata granosa (Schoepff.).

A gravid specimen showing the greatly enlarged condition of the genital system. E., eggs; Od., oviduct; Re., ruptured eggs.

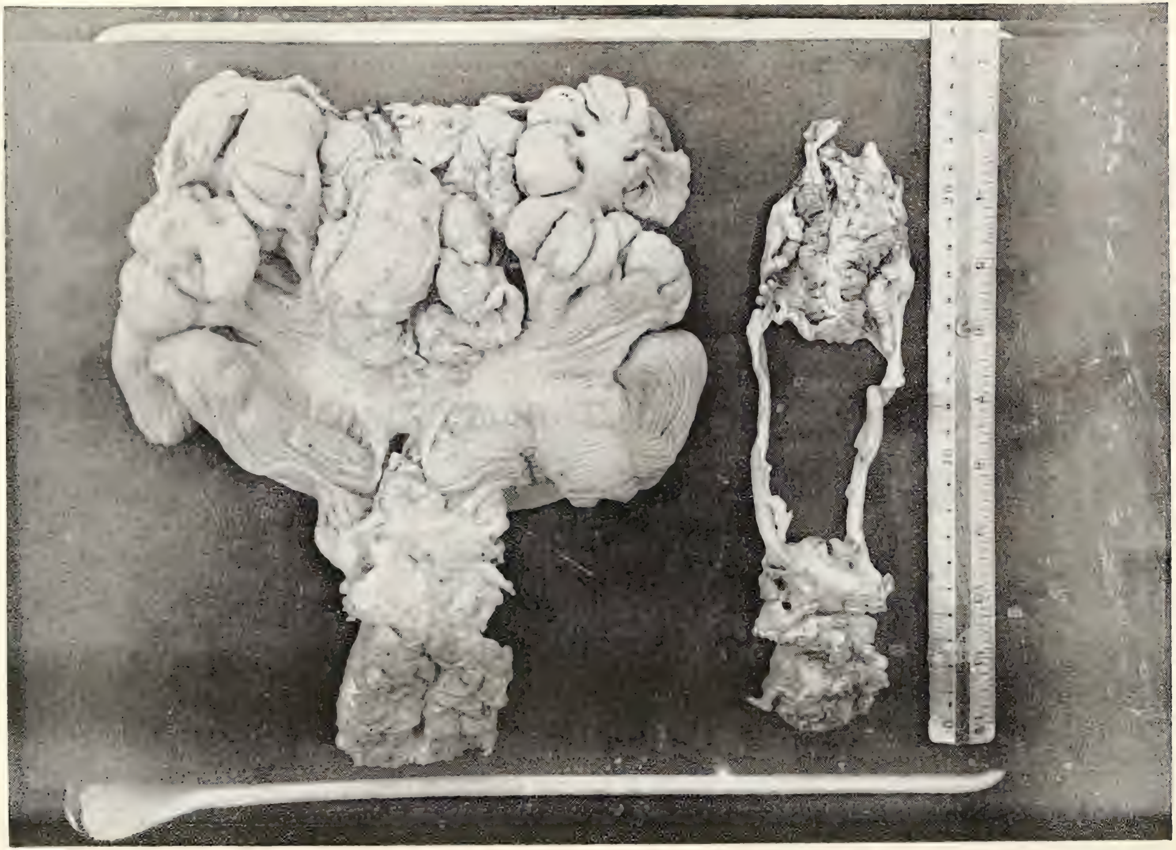


Photo : *C. McCann.*

Crocodilus palustris Lesson.

Active (left) and dormant (right) ovaries.

from below, i.e. the side of the sulcus, the penis appears as though it were composed of two halves, the sulcus forming the dividing line. At the proximal end the fibrous tissue forms two large reversedly club-shaped bodies (*Crus*) narrowing towards the distal end and then widening again to form the terminal lobed extremity. The sides of the penis between the two extremities are somewhat flattened about the middle. Viewed in profile there is observed a distinct upward bend about the middle of the organ. The distal extremity is enlarged, and as already mentioned, lobate. There are two main lips; the upper forming a rigid hood over the cavity formed between the two; the upper lip is firm, broadly ovate, with a deep cleft at its tip; the lower is boat-shaped and slightly in-curved and exceeds the upper lip in length; its distal extremity terminated in two somewhat triangular flaps on either side of the sulcus. From the lower lip a median ridge, which increases in height, runs down into the cavity formed by the two lips. The sulcus arises out of a tubular structure at the proximal end, between the fibrous bodies, and extends forward to the extremity of the lower lip, it is bordered by subfleshy ridges. The structure and position of the organ suggests a ventral union of the sexes and a copulatory hold during coitus. However, the correctness of this suggestion must be proved by actual observation. It also seems possible that coitus in these bulky animals takes place in water.

The Female Cloaca.

A reference to copulation without a consideration of the female genitalia and its morphology would be incomplete, therefore I must give a brief description of it as well.

The text-books make no reference to the female cloaca in particular, but describe the cloaca in general terms which apply to both sexes. However, for the purposes of this paper it becomes necessary to differentiate not only between the cloaca of both sexes, but to consider them *in* and *out* of the breeding season. There is little or no change in the case of the male, except for the fact that the testes and ducts display a marked reduction or increase in size according to the seasons. In the female, however, there are very marked physiological changes which take place from the active to the inactive condition of the ovaries. This point is perhaps well-known, but I drew attention to it in my articles on Amphipia and Reptiles published in the *Journal.* The changes are of particular significance when we consider the subject of copulation, particularly in reptiles with bifid introversal organs.

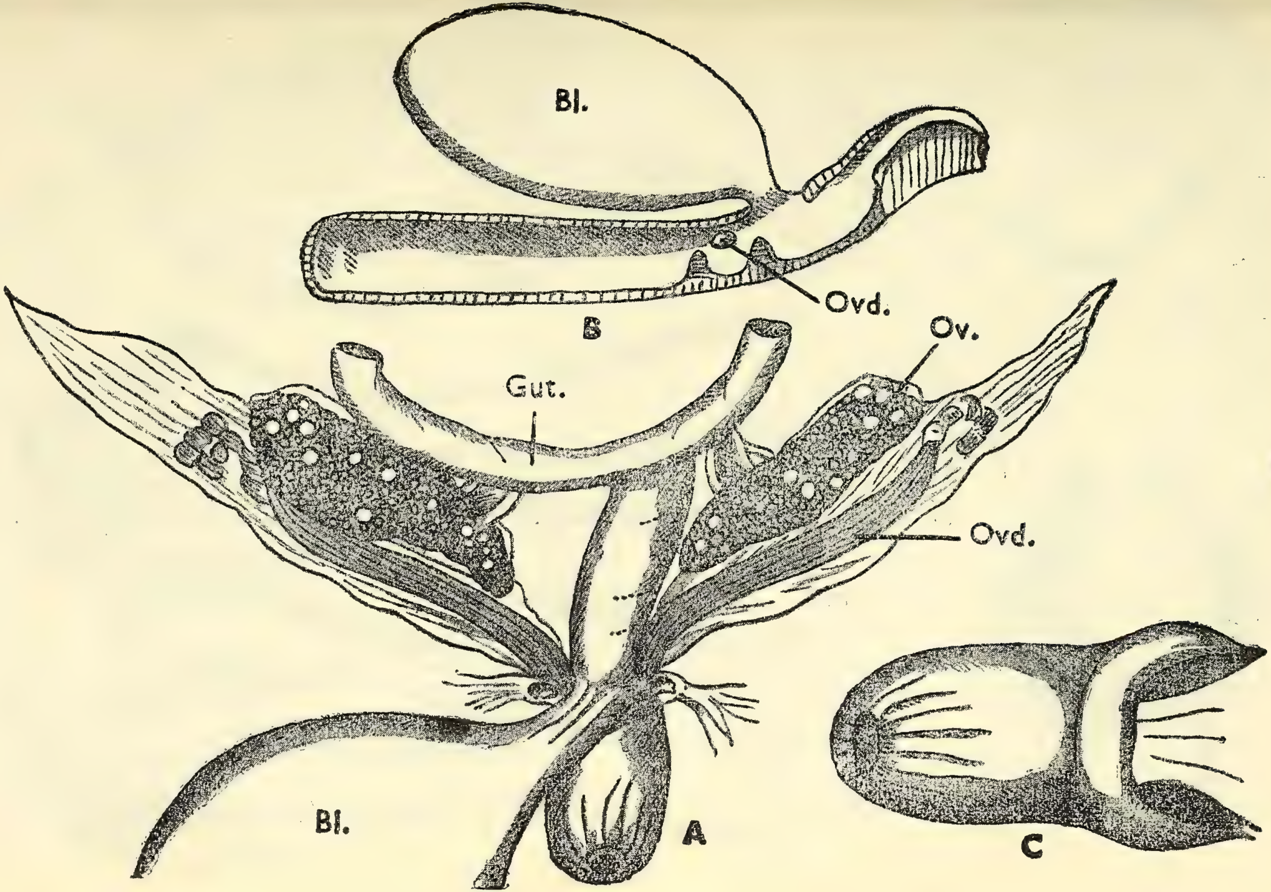
Snakes: The cloaca of a female snake, when its ovaries are in an advanced state of activity, is not as well defined into three compartments as in lizards. The coprodaeum is confluent with the hind end of the gut from which it is barely distinguishable. In a fresh state (as in lizards) its opening almost reaches the last chamber or proctodaeum thus preventing the fouling of the middle chamber or urodaeum to any great extent. The urodaeum is formed by a dorsal invagination into a comparatively enlarged, saccate chamber which opens posteriorly into the proctodaeum.

The proctodaeum is comparatively short. The wall of both the urodaeum and the proctodaeum are thrown into longitudinal (fluted) folds. The proximal ends of the oviducts are considerably enlarged into oblong, thick-walled, glandular chambers which open directly into the dorsal portion of the urodaeum. These chambers apparently function as 'shell glands'. Unlike the lizards these 'shell glands' are not separated by a narrowed portion of the oviduct from the urodaeum. This description is based on median sagital sections made through the cloacas of preserved specimens of *Natrix stolata* (Pl. VI, E,F.) and *Naja naja,* and a freshly killed *Ptyas mucosus;* all gravid. I could find no appreciable difference between the species. It is worthy of note that, apart from the general reduction of the organs during the inactive ovarian period, the opening of the oviducts are closed.

Lizards: According to my observations the cloaca during the active condition, is as follows: (Pl. IX F.—H.)

The cloaca is well differentiated into three compartments, the coprodaeum, urodaeum, and the proctodaeum. The coprodaeum at its hindermost end forms a mammilate, extensible tube which enters the urodaeum. It is supported by a suspension membrane from the mid-dorsal line of the urodaeum. This membrane partially divides the urodaeum into two halves. The urodaeum is separated from the proctodaeum by a sphincter partition. On the dorso-lateral sides of the urodaeum, and just above the protruding end of the coprodaeum are the entrances of the oviducts. The entrances to the oviducts are large, the portion just above them is elastic and is easily dilated without undue pressure from within. The opening of the proctodaeum to the exterior is closed by a strong fold of the external skin. A point worthy of note, in passing, is that the mammilate portion of the coprodaeum, suspended within the urodaeum is able, on extension, to reach the orifice formed by the sphincter separating the urodaeum from the proctodaeum, a device which probably prevents the fouling of the urodaeum during defaeciation. (The above description is based on a freshly killed specimen of *Hemidactylus maculatus* in breeding condition.) (Pl. IX, figs. F—H.) IX, D,E.

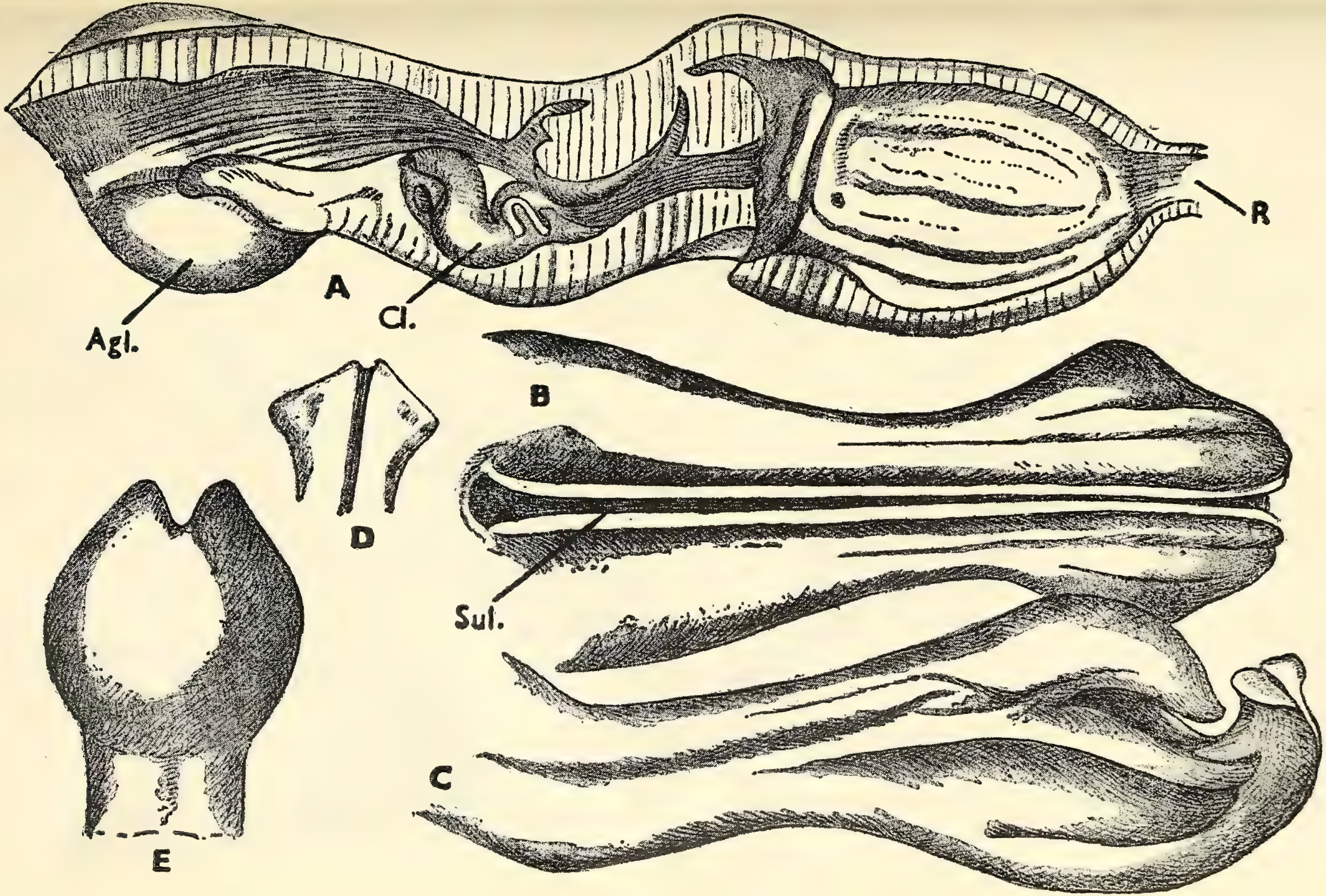
Testudines: The cloaca of a female mud-turtle (*Lissemys punctata*) during the period of ovarian inactivity does not exhibit a clear differentiation into the chambers characteristic of the lizards. The terminal portion of the gut is cut off from the urodaeum by a sphincter. Posterior to this sphincter another sphincter shuts off the much reduced urodaeum from the rest of the posterior end of the cloaca. Beyond the posterior sphincter the urinary bladder opens on the ventral floor of the cloaca. Immediately following the narrow neck of the bladder is a dense-tissued collar, the arms of which reach to the posterior sphincter. From the dorsal surface, but outside the passage of the proctodaeum, arises a solid, fibrous, clitoris-like structure which protrudes into the cloaca, but not through its wall; this body is seated on a somewhat spongy base which allows of a certain amount of movement to it. The walls of the proctodaeum are thrown into somewhat obscure folds. The oviducts enter the much reduced urodaeum and in this



Del. C. McCann.

Uro-genital system of Lissemys punctata granosa (Schoepff.).

A, entire system; B, long-section through cloaca; C, terminal, portion of cloaca; Bl., bladder; Gut., portion of alimentary canal; Ov., ovary; Ovd., oviduct.



Del. C. McCann.

Crocodilus palustris Lesson.

A, Cloaca of female; B-E, penis; B, distal portion, 'ventral' aspect; C, the same, lateral aspect; D, extremity of lower lip; E, upper lobe, top view; Agl., Anal gland; Cl., clitoris; R, gut; Sul., sulcus.

condition of sexual inactivity they are imperforate; the openings are somewhat laterally situated. (Pl. IV, B.)

In an example exhibiting ovarian activity in an advanced state there is a considerable enlargement of the oviducts and the now perforate openings. The ova occupy much space in the abdominal cavity. (Pl. II.)

Crocodilia: The text-book descriptions of the cloaca in these Saurians are as follows:

> *Sedgwick* (4): 'The cloaca is divided into two parts by a muscular fold. Into the anterior chamber open the urinary and generative ducts by separate and paired openings. There is no bladder. On the ventral side of the posterior chamber of the cloaca is a grooved penis very similar to that of Chelonia. Peritonial canals are present in both sexes and open on either side into the cloaca at the base of the organ.' (*l.c.*, p. 379.)
>
> *Parker & Haswell* (7): 'In Crocodilia and Chelonia, instead of the copulatory sacs there is a median solid *penis* attached to the wall of the cloaca, and a small process or *clitoris* occurs in a corresponding position in the female.'
>
> *Smith* (15): 'The cloaca is formed as follows:—The coprodaeum and urodaeum are confluent and form a large oval bag, closed in front and behind by strong sphincters. Normally it acts as a receptacle for urine, and into it also opens the oviducts, near the base of the clitoris. The proctodaeum or outermost chamber contains the large unpaired penis. This arises from the ventral wall of the chamber and has a deep longitudinal groove on its dorsal aspect to conduct the seminal fluid. On either side at the root of the penis opens the peritonial canal. The outer opening of the cloaca is a longitudinal slit, and within it, placed dorso-laterally, are the two anal musk-glands.' (*l.c.* p. 34.)

The following are my own observations on the cloaca of a female crocodile during her period of ovarian activity:

The anterior chamber is large and is suspended dorsally by a strong suspension membrane. Internally the walls of the chamber are thrown into several deep, longitudinal folds: its posterior end widens into a large cavity; apart from the folds already referred to, the walls of the chamber are much vermiculately rugose throughout. From the posterior enlargement a narrow, much longitudinally fluted passage passes backwards under a dense-tissued, fluted, bulbous knob, arising from the mid-dorsal surface; the knob is posteriorily notched. Just beyond this dorsal protuberance, arises, from the ventral floor of this passage, a peniform clitoris with its distal extremity directed towards the opening of the vent. The walls of this passage are deeply longitudinally furrowed. The oviducts are much enlarged and longitudinally furrowed. The oviducts both enter the anterior chamber of the cloaca, the openings being somewhat dorsal in position. (Pl. V, fig. A.)

In reptiles the period, between the commencement of the reduction of the gonads and the beginning of their regeneration to activity, corresponds roughly to the period when the desire for food is predominent, namely, the period when the animals are not aestivating or hibernating as the case may be. This period is devoted to feeding activity and the consequent storage of large accumulations of fat in tissues especially assigned for the purpose. The marked reduction in the size of the genital organs from the greatly enlarged active condition to the much reduced inactive state makes room for the accumulation of fat that would not be possible if this change did not take place. At the end of the period of activity, the genitals once more commence to show signs of returning activity. It is at this time that the animals embark on their period of aestivation or hibernation as the case may be. It is during the inactive life of the animal that the genitals develop to their maximum. Most of the stored fat is gradually absorbed and the area occupied by it is once more filled to capacity by the enlarging genitals, particularly in the case of the females. Thus the animal's life may be divided into two main periods: (1) the feeding period, and, (2) the period of sexual activity (including the period of hibernation or aestivation and the actual union of the sexes).

In a female with inactive ovaries, the cloaca displays no marked peculiarities, for during that period the entire genital system is reduced to a minimum and in some instances the organs atrophy to such an extent that the animals become difficult to sex with any degree of certainty without careful dissection. On the contrary, when the ovaries are active there is a marked increase in the size of the ovaries themselves and a corresponding enlargement and appearance of the oviducts and the walls of the cloaca. Both the latter become more 'spongy' and furrowed to give the necessary elasticity for the passage of the eggs. The ova mature within the body cavity, and when ripe break away and enter the funnel-shaped opening, the *ostium abdominale,* of the oviducts. Fertilization takes place in the oviducts, for it is only when the ova are in a fairly advanced condition that coitus takes place. This has been my experience with such reptiles as I have observed and dissected after coitus. At this period the oviducts are at the fullest development and the aperatures to the exterior are at their largest.

What are we to conclude from these observations? The only reasonable answer is that as the genitals are so reduced during the inactive period, coitus is physically impossible, and as far as I am aware does not take place, not to mention the possible absence of any desire to cohabit during such a period (the reproductive organs being reduced or atrophied. There is no marked reduction in the size of the hemipenis).

From these considerations we must pass on to the postures assumed by reptiles during coitus.

POSTURES ASSUMED DURING COITUS.

Snakes: Snakes have no limbs. The copulating pair, like a fighting couple, at first entwine themselves, rope fashion, and approximate the vents. It is only then that the male organ is inserted and coitus ensues. Whether the male uses its jaws in obtaining the first hold on the female, I am unable to say, but as I have observed a similar practice in other reptiles, such as lizards, I am inclined to the view that the same may obtain among snakes. Once the sexes are united in copula it appears to be immaterial whether they remain entwined or not. On this point we have some meagre evidence.

Col. Wall (10) writing in the *Journal* on the evidence of Mr. Hampton wrote the following in regard to a couple of cobras (*Naja naja*):

> 'In Trivandrum the pair remained coupled from 11 a.m. until 4-20 p.m. on the 17th January. In Mr. Hampton's vivarium coitus lasted intermittently for three days. He observed that the pair nodded their heads continually, and their bodies quivered. They did not take the slightest notice of anybody in front of the cave. They did not expand their hoods, neither did they wrap themselves around one another. Each turned the vent upwards and sideways to effect engagement.' (xxii, 550.)

Unfortunately the observer tells us nothing of the first engagement and so we must conclude that he did not witness it and that the observations refer only to the period after engagement had already taken place. Some important details arise out of these observations, namely, (*a*) coitus may be protracted for several hours; (*b*) that it is repeated periodically, (*c*) that the couple were not entwined during the process. Similar facts I have observed in certain lizards. Another instance of snakes in copula was recorded in the *Journal* together with a photograph by Mr. A. R. Poyntz (14). In this instance the animals concerned were sea snakes. They were hauled out of the sea by means of a boat-hook. Both were entwined and remained so when put on shore, in spite of the rough handling. In volume xxxvi (15) of the *Journal* there is a plate illustrating two phases during the copulation of two Rat-snakes (*Ptyas mucosus*). Figure 2 of this plate shows the pair entwined, which appears to be an earlier stage than figure 1 illustrating the pair unwound, but with the two vents still approximated. However, further close observations are necessary on these details.

Lizards: Although lizards generally possess well-developed limbs I have observed no true copulatory hold in these animals. After a brief period of manoeuvring round, the male generally makes a rush at the female grasping her fiercely by his jaws at the back of her neck, often wounding her in the effort. The vents are approximated and the union of the sexes ensues. At this juncture the male releases his partner's neck and remains stationary until separation takes place. The duration of coitus varies and is repeated at intervals. Like snakes, lizards possess a divided copulatory organ. A point that is worthy of mention in passing, is that coitus usually takes place when the ova are already in the oviducts. I shall have occasion to refer to this point later.

Testudines: During coitus the male supports itself on the shell of the female, and remains in position by its own weight, but there is no hold in the true sense. It is common knowledge that the plastron in many species is very distinctly hollowed in the males. The sexes may remain in the copulatory attitude for a considerable length of time.

Crocodiles: I can find no reference to a pair of crocodiles having been observed in copula, hence we have no information on the subject as to the presence or absence of a copulatory hold.

After considering the copulatory poses assumed in the various groups of reptiles, we find that it is among such groups as do not employ a true copulatory hold during coitus, that we find a paired organ. In both groups the period of union is usually protracted and separation takes place only after retraction of the organ. As there is no hold to secure the sexual position till the act is consummated we must turn once more to the structure of the organ when it is everted to its fullest for an explanation of its functions. A pertinent question arises as to whether we are dealing with a single or dual organ. This point must be disposed of first.

IS THE HEMIPENIS A SINGLE OR DUAL ORGAN?

The word *hemipenis* itself suggests that we are dealing with 'half' an organ. The point is, Do the two halves unite together to form a single organ, or, does each part form a separate functional organ, one independent of the other? As already indicated, each hemipenis (when everted) has a longitudinal groove, the proximal end of which is confluent with the opening of the ureter to which the seminal ducts are connected and through which the seminal fluid enters the sulcus up the hemipenis. Then there are the very significant points that (*a*) both hemipenes are everted when pressure is applied to a certain point below the vent just above the organ (at rest); (*b*) when forcibly everted there is a strong tendency for the two to curve outwards, i.e. away from each other (this and the previous point I have confirmed repeatedly by experiment); (*c*) there is the fact that the head of the penis is much dilated when fully everted; (*d*) there is no copulatory hold during actual coitus in animals that possess a hemipenis. Taking all these points into consideration I am inclined to the view that we are dealing with a single organ composed of two halves. The reasons for such an opinion are perhaps obvious, but for sake of clarity it will be better to express them:

(*a*) the two halves of the organ when everted together result in approximating the two sulci, thus forming a 'complete' tube at least in its lower portion for the conduction of the seminal fluid;

(*b*) the dilated heads of the organ establish a firm copulatory hold within the female, thus dispensing with the need for an external hold during coitus.

From these considerations and conclusions we must pass to another aspect of the cloaca. In snakes and lizards the openings of the oviducts to the exterior are very near the vent itself, they open into the urodaeum. There is no vagina as in higher animals. Such large organs as the hemipenis when fully everted could not be accommodated in the cloaca alone. This to my mind is a very significant point. In the crocodiles and chelonians there is sufficient space to accommodate the penis. Again, it must be remembered that more often than not, the ova in both oviducts are fertilized. Spermatozoa received into the cloaca alone would, I think, in all probability not reach the ova to produce maximum fecundity as is generally the case. I readily realize that this view may call forth serious objections on account of the motility of spermatoza, but, for the present I introduce the suggestion merely by way of argument. Another point not to be lost sight of is the absence of the copulatory hold in animals possessing a hemipenis, namely snakes and lizards. Taking these points into consideration, I am of the opinion that at the time of coitus both halves of the organ are inserted, and further, that the distal heads enter the openings of the oviducts themselves. The large heads thus provide a sufficient lock to prevent the extraction of the organ during the passage of the seminal fluid. The union of the lowest portions of the two sulci form an adequate tube in the cloaca, and the upper portions a passage into the oviducts.

A point perhaps worthy of consideration is that snakes and lizards are 'belly walkers'; the body being usually adpressed to the ground. In animals with such a mode of progression a median, enlarged, solid penis would be somewhat of a hindrance during progression. The saccate, reversable and divided organ is more comfortably accommodated under the caudal vertebrae, apart from the fact that they perform the function of claspers during coitus. Another point worthy of note, though it has no direct bearing on the subject in hand is, that according to Wall's (12) observations the hemipenis is extruded in embryos. He wrote as follows:

> 'The brood (of *Hydrophis spiralis*) in an advanced stage of development included 10 males and 4 females. The males (with the genitals extruded) measured...' (xxvi, 432).

Again in regard to the embryos of Russell's Viper (*Vipera russellii*) the same author states:

> 'The genitalia of the male are extruded up to about four days before exovation.' (xxvi, 432).

Having reviewed the many and complex aspects of sexual activity in the various groups, I shall now pass on to the description of the male genitalia in the species I have had the opportunity of examining in freshly killed animals. I also introduce the descriptions given in the *Fauna* (23) and those of Col. Wall in his various works by way of comparison.

DESCRIPTIONS OF THE MALE GENITALIA UNDER SPECIFIC HEADS.

Serpentes or Snakes.

BOIDAE.

Python molurus (Linn.) (Pl. I fig. 4. & VII fig. 1.)

The hemipenis of *Python molurus* and *P. reticulatus* are defined in the quiescent state in the *Fauna* (23) as follows:

> 'It is forked for about half its length, the lips of the sulcus being very prominent; throughout the whole length there are longitudinal folds, and just proximal to the point of bifurcation of the sulcus there is a fleshy tongue-shaped papilla; there are no spines.' (*l.c.*, p. 105.)

Everted aspect: In the fully everted condition the hemipenis resembles the fruit of *Trapa bispinosa* (the Water Chesnut) on its pedicil. The pedicil is well differentiated from the head; it bears no spines or excrescences but just below the base of the head are two distinct fleshy collars almost entirely encircling the pedicil. They are broken by the sulcus. The lower of the two collars is stouter and exhibits a nodular excrescence on the side opposite to the sulcus. The upper is feebler and undulated. The head is broadly triangular in outline with a retuse depression at the distal extremity. The two free ends of the triangle each bears a slightly recurved papilla at the base of which are a few fascet-like depressions. The surface of the pedicil and the head exhibit very shallow fissures which probably represent fold lines. The sulcus arises at the base of the organ and is represented by a comparatively deep groove bordered by somewhat stout ridges. At the base of the head the sulcus branches dichotomously, the branches turning towards the outer faces of the head and finally terminate in the grooves below each papilla. The outer margins of the sulcus are surmounted by fleshy folds which have a tendency to turn inwards.

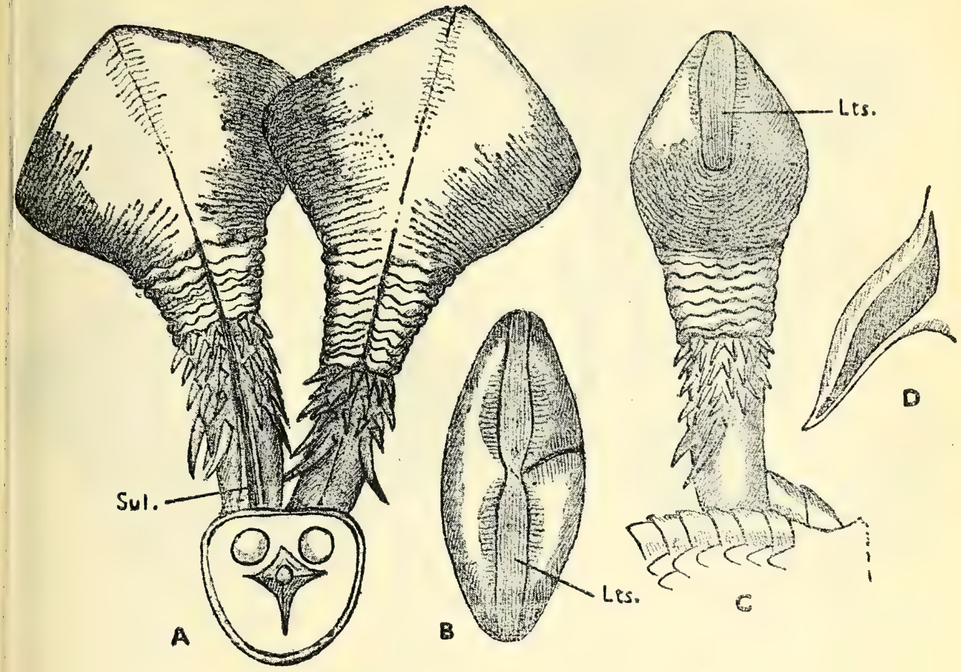
COLUBRIDAE.

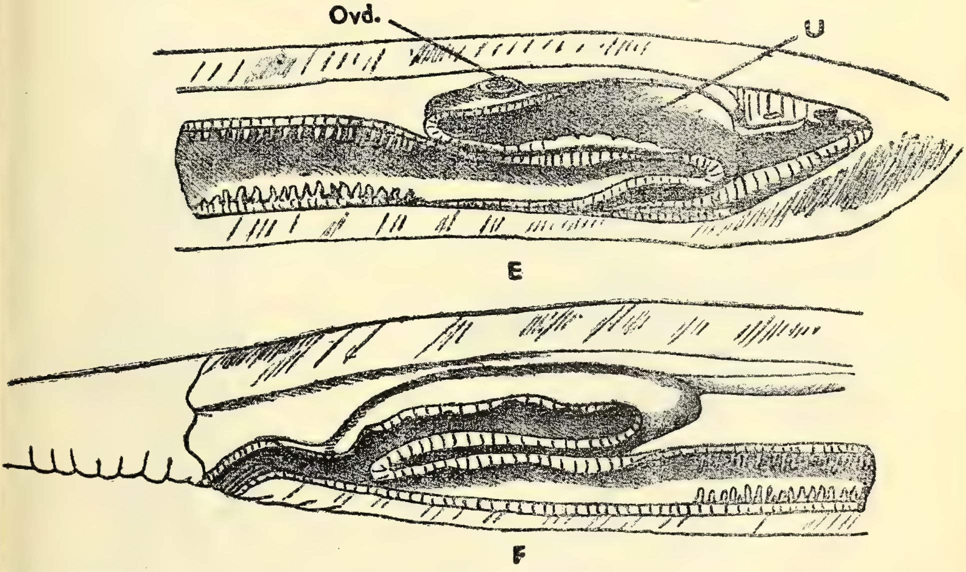
Ptyas mucosus Smith (Pl. I fig. 6 & 7) (Pl. VII fig. A-D.) & text-fig. 3.

The *Fauna* (23) describes the hemipenis as follows:—

> 'Hemipenis extending to the 10th-12th caudal plate, not forked. The distal one third is flounced, the folds at the tip being much finer than those proximally: this area is followed by one of almost equal length in which the flounces are much thicker walled and joined together in part to form the calyces; it is succeeded abruptly by a spinose portion, the spines being thick and fleshy, and terminating in a spicule; there are 11-12 in lateral series; at the base of the organ there are two very large spines. In addition the distal one-half or one-third is incompletely divided in two by invaginations of the external wall of the organ. The connection between them is maintained by connective tissue and is intimately connected with the sulcus. In general character the structure is that of *Zaocys carinatus* but the modifications are less developed.' (*l.c.*, p. 160.)

Everted aspect: In the fully everted condition the hemipenis of *P. mucosus* is more complicated in structure and more difficult of description than that of *Python molurus*. The pedicil, which is well defined, supports a broadly quadrangular head which rests on one of its angles. For a short distance the proximal end is smooth all round; this is followed by an area of spines of almost equal length, the spines decreasing slightly upwards. At the base of the spinous area, on the side opposite to the sulcus, there are 2-4 spines much larger than the rest; the spines on the same side as the sulcus are smaller than those opposite. Each spine has a hard whitish core surrounded by translucent tissue. The extremity of the core protrudes externally as a sharp spicule. Immediately above the spinous area there is a deeply flounced area extending to the base of the head, the flounces decrease in size upwards and pass into the rugose area of the head. The flounces encircle the pedicil but their continuity is interrupted by the sulcus on the inner aspect.





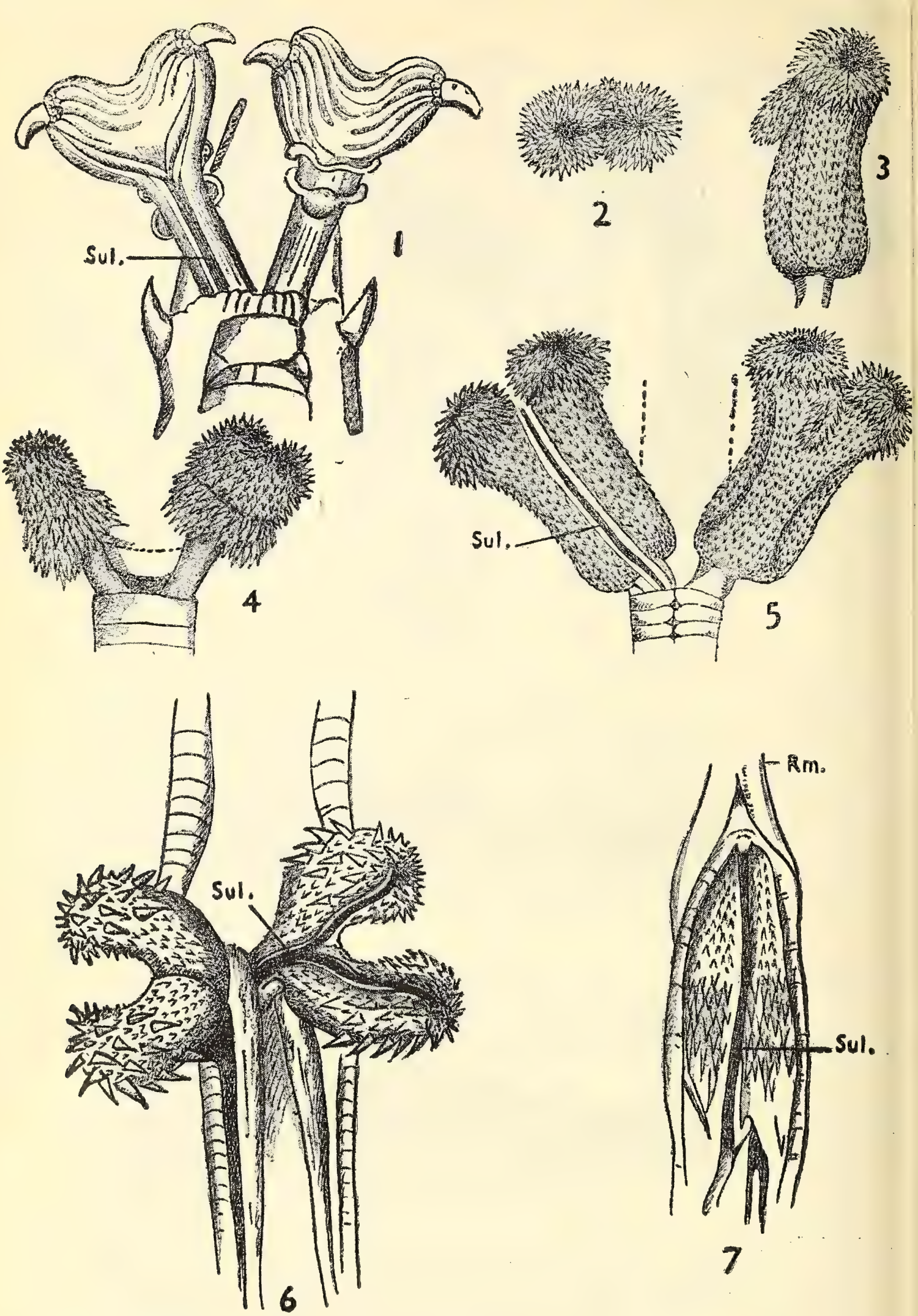
el. C. McCann.

Hemepenis of Ptyas mucosus Günther—A-D.

A, The paired organ back & front; B, Top view; C, Lateral aspect; D, Spine; Sul., Sulcus; Lts., lateral rib.

Cloaca of Natrix stolata Pope—E. & F.

Cloaca of a female with eggs in the oviducts, showing enlargement of urodaeum. Ovd., oviduct; U., urodaeum.



Del. C. McCann.

Hemipenes of Snakes.

1, *Python molurus* (Linn.); 2, 3 & 5, *Natrix piscator* (Schneider); 4, *Bungarus caeruleus* (Schneider); 6, *Vipera russullii* (Shaw), everted; 7, *V. siamensis* Smith (drawing after Smith) reverted.

The quadrangular head when fully distended is somewhat transparent, especially towards the distal region. The angles are rounded. The supporting stays of somewhat cartilaginous tissue are clearly visible extending from the two lateral angles to the distal or topmost angle (Fig. 3. Lts.). The surface of the head is shallowly flounced below, the flounces gradually passing into oblique rugose ridges which become almost obscure or obsolete towards the central area, but reappear along the central axis. The sulcus is well defined along the pedicil but gradually fades out except for a ridge along the wall of the head. On the opposite side to the sulcus there is also a fine ridge corresponding to it in position. At the base, the sulcus is bordered by somewhat strong ridges.

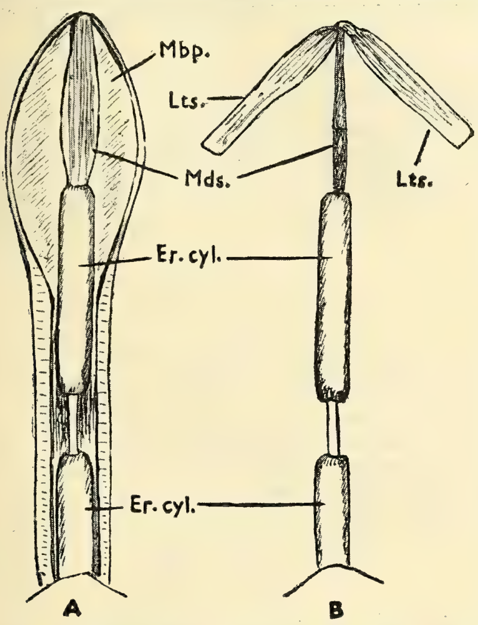


Fig. 3. Diagramatic sections of the hemipenis of *P. mucosus*. Er. cyl. = erectile cylinder; Lts. = lateral stays; Mbp. = median septum; Mds. = median stay.

Internal aspect: A long section of the hemipenis exhibits the following: Within the pedicil there are two cylindric bodies (Fig. 3. Er. cyl.) of erectile tissue separated from each other by a much finer cylinder. Both the large cylinders are attached to the walls. The upper of the two extends for a short distance into the head. At its distal end is ligulate somewhat cartilaginous body (Fig. 3. Mds.) reaching the top of the head. At this point the ligulate structure supports two semi-cartilaginous 'stays' which extend to the lateral corners. A thin transparent membrane (Fg. 3. Mbp.) divides the interior of the head into two; it extends from the side of the sulcus, across, to the opposite wall.

Coluber ventromaculatus Gray & Hardwicke.

The *Fauna* (23) describes the hemipenis as:

> 'Hemipenis extending to the 10th caudal plate; the calyculate area occupies 1/3 of the organ, the cups being deeply scalloped and spinose; this area merges gradually into a spinose one, the spines being more or less uniform in size; there are about 20 lateral series.' (*l.c.*, p. 168.)

Col. Wall (11) writes:

> 'The ♂ claspers in adults are studded with hook like horny appendages' (xxiii, 41.)

Lycodon striatus (Shaw) Stoliczka.

The *Fauna* (23) describes the hemipenis of this species under *L. jara;* it reads:

> 'Hemipenis extending to the 10th caudal plate; the distal 1/3 is obliquely flounced and calyculate, the remainder of the organ spinose, the spines being large and more or less equal sized throughout.' (*l.c.*, p. 261.)

Col. Wall (6) writes:

> 'The male organs are beset with numerous minute claw-like appendages.' (xix, 104.)

Lycodon aulicus (Linn.) Guenther.

Regarding the hemipenis the *Fauna* (23) states:

> 'Hemipenis extending to the 10th caudal plate; forked near the tip; the distal 1/3 is calyculate, the calyces being transversely arranged; the remainder of the organ has longitudinal folds which are beset with more or less distinct spines; starting from the calyculate portion of the organ and extending about half-way down, are two prominent folds composed of a number of short, flesh papillae.' (*l.c.*, p. 264.)

Col. Wall (6), writes:

> 'The copulatory male organs are beset with many minute recurved spines.' (xix, 97.)

Everted aspect: In the fully everted condition the hemipenis is comparatively short. The pedicil is stout, and occupies approximately 1/3 its total length being unarmed, and fully differentiated from the head. The head is somewhat obovately trigonous, and is armed with comparatively large curved spines, increasing in length towards the distal extremity. Each spine is embedded in a somewhat translucent membrane with a free and sharp extremity. The sulcus is deep, and extends up one of the angles terminating in the 'pit' formed by the invagination and is margined by thick lips.

Natrix piscator (Schneider) Smith (Pl. I fig. 5) & (Pl. VII. figs. 2, 3, 5.)

With regard to the construction of the hemipenis in the genus *Natrix* the *Fauna* (23) records the following:

> 'Hemipenis reaching the 7th or 8th caudal plate[1], spinose and calyculate throughout, the spinies being more or less uniform in size. The lips of the sulcus are short or very short, the spines originating within the cup; at the base of the organ there are 2-4 large or very large spines.' (*l.c.*, p. 281.)

Under the specific head of *N. piscator*:

> 'Hemipenis extending to the 12th caudal plate, forked for about one-third of its length; it is spinous throughout, the spines being relatively coarser at the distal end than at the proximal; extending for the greater part of its length are four prominent folds; there are no basal spines.' (*l.c.*, p. 294.)

Everted aspect: In the fully everted condition the hemipenis of *N. piscator*, the large columnar head occupies the greater part of the organ. The pedicil is very short. The head is large, bluntly quadrangular and bifid at the extremity; each bifurcation terminates in a somewhat spherical head which is invaginated at the apex. The side opposite to the one bearing the sulcus exhibits a median prominent hump just below the thivision between the two distal hemispheres. The whole surface of the head is covered with small almost uniform recurved spines, except its basal end; in the distal region and on the hump the spines are a little larger. On the side of the sulcus very shallow fissures run obliquely upwards away from it, to the angles. The sulcus is well defined and runs up to between the lobes; at this point it bifurcates and furrows lead up to the invaginations at the top of the distal lobes.

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[1] There is a slight discrepancy between these figures and that given under the specific heading below.

Atretium schistosum (Daudin) Guenther.

Regarding the hemipenis of this species the *Fauna* (23) records:

'Hemipenis forked at the junction of the distal 1/3 and the proximal 2/3, spinose and calyculate throughout; the calyces are thick-walled and present a honey-combed appearance; the spines are small and on the floor of the calyces.' (*l.c.*, p. 320.)

Col. Wall (9) states:

'The ♂ clasper is beset with numerous falciform processes from the base to the tip.' (xxi, 1013.)

Psammophis condanarus (Merrem) Boulenger.

The *Fauna* (23) refers to the hemipenis under the generic heading; it reads as follows:

'The hemipenis is long and extremely slender, so slender that I have been unable to make a proper examination of it from the material at my disposal. It has neither spines nor calyces but is provided with longitudinal folds. It does not differ from the five species dealt with in this book.' (*l.c.*, p. 362.—quotes Wall.)

Col. Wall (8) records:

'The male claspers I have found peculiar, differing from these organs in other snakes in that when forcibly extruded by digital pressure behind the vent they were directed downward instead of forward. They are thin, long, and spirally twisted reminding me of a black buck's horn. Again they are entirely lacking in asperities or tentacles such as one usually sees on these organs in other snakes.' (xx, 630.)

ELAPIDAE.

Bungarus caeruleus Boulenger. (Pl. I fig. 2.) & (Pl. VII. fig. 4.)

The description of the hemipenis in the *Fauna* (23) is applicable to the genus. It reads as follows:

'The hemipenis extends to the 6th-9th caudal plate; the distal one-third or half is calyculate, the remainder spinose. The calyces are smallest near the tip of the organ and increase in size as they approach the spinose area. Each cup is stiffened by spine-like structures, which, like the ribs of an umbrella, hold the membrane and projects beyond the margin. The transition from the calyculate to the spinose area is fairly abrupt, the largest spines are those nearest the calyces; they are thick and papilla-like in form, and bear a small sharp spine at the tip. The bifurcation of the sulcus is about the middle of the calyculate area or at the junction of the calyculate and spinose areas, and the lips of the sulcus are beset with small spines throughout. I have found considerable variation within the species as regards the number and form of the spines.' (*l.c.*, p. 408.)

Everted aspect: In the fully everted condition the hemipenis of *B. caeruleus* is well demarcated into pedicil and head. The pedicil is comparatively short and slender, and its surface is smooth. The head is somewhat oblong or ovate-oblong with a distinctly retuse apex; about its middle there is a constriction which separates the two areas of large and small spines. The spines are larger in the lower portion while those above the constriction are smaller and prickle-like. The sulcus is somewhat shallow but is well defined; it bifurcates just below the retuse apex and the arms loose themselves among the prickles.

Naja naja (Linn.) Nikolosky.

The *Fauna* (23) describes the hemipenis as:

> 'Hemipenis extending to the 10th caudal plate, forked opposite the 7th; it is divided into three areas, which are fairly abruptly defined from one another, namely a proximal one beset with minute spine, a median one with very much larger spines, and a distal calyculate area, the cups being poorly developed and having spinose edges. The median area is further interrupted by a narrow transverse, smooth area, which does not, however, intercept the sulcus or its two adjacent longitudinal ridges.' (*l.c.*, p. 429.)

Col. Wall (10) writes:

> 'The male clasper is narrow and long surmounted with very small claw-like tentacles. It is not bifid.' (xxii, 550.)

HYDROPHIIDAE.

Hydrophis cyanocinctus Daudin. (Pl. I, fig. 1.) & Text-fig. 4.

The *Fauna* (23) describes the hemipenis as:

> 'Hemipenis forked near the tip, and spinose throughout, except near the base, where there are longitudinal folds; the edges of the sulcus are also spinose.' (*l.c.*, p. 455.)

Everted aspect: The hemipenis in this species is comparatively small with a strong tendency to recurve. In shape it is somewhat obconic. The pedicil is shorter that the spinous head and is somewhat lobate. The head is elongately subcylindric, narrowing towards the pedicil; its distal extremity is shallowly invaginated; its surface is spinose throughout with the largest spines nearest the pedicil (the difference in the length of the spines is not very marked). The sulcus is comparatively deep and its margins thrown into folds (rather lobed). It terminates in the invagination.

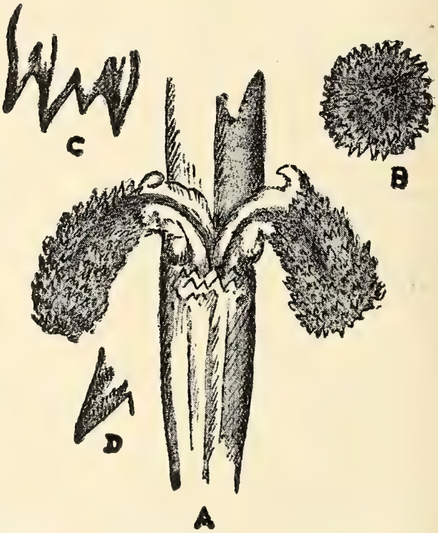


Fig. 4. Hemipenis of *H. cyanocinctus*: *A*. Entire organ; *B*. Top aspect; *C*. multiple spine; *D*. Simple spine.

Hydrophis caerulescens Smith.

The description of the hemipenis in the *Fauna* (23) reads:

> 'Hemipenis forked close to the tip; this is furnished with coarse flattened, papilla-like structures arranged in longitudinal series; the remainder of the organ is spinose, the spines being of moderate size, closely set and becoming slightly larger as they approach the base.' (*l.c.*, p. 463.)

Everted aspect: The hemipenis of this species is very similar to that of *H. cyanocyncta* in shape and behavous when everted. The pedicel is about half the length of the head and is somewhat lobate. The head is subcylindrically obconic; its surface is spinous, the spines being a little larger at the base than above. The fleshy investments of the spines are connected to one another. The sulcus is comparatively deep and its margins are lobed and spinous; it leads into the invagination at the distal extremity.

Col. Wall (3) writes:

> '. . . the main stem when the organ is protruded, being about half an inch in length. . . . The organ of one side is invaginated as it would be during the act of coition. I have never observed this pecularity in other snakes. Is it a viperine characteristic?' (xv, 526.)

Note: None of the specimens of *Hydrophis* I have so far examined exhibit a forked distal extremity.

VIPERIDAE.

Vipera russellii Shaw. (Pl. I, fig. 3.) & (Pl. VII, fig. 6.)

In describing the hemipenis of *V. russelli* the *Fauna* (23) states:

> 'Hemipenis extending to the 10th caudal plate, forked opposite the 2nd to 3rd; calyculate in the distal half, spinose in the proximal, the largest spines being nearest to and extending beyond the fork.' (xviii, 483.)

Col. Wall (5) states again:

> 'The male genitals are peculiar. The clasper on each side is bifid, a character, I believe to be found in all vipers. I have also observed the same condition in the sea-snakes, but not in any other colubrines. In a male 3 feet 7 inches in length, the main stem of each clasper was about half an inch long.' (xviii, 13.)

Everted aspect: In the freshly everted condition the hemipenis of *V. russellii* naturally presents a very different picture from what is described above. The pedicil is extremely short and the distal end may be described as 'sessile'. What is visible of it is encircled by fleshy annuli. The head is remarkably U-shaped, the extremity of the two arms being deeply invaginated; its surface is covered with short prickles intermixed with large spines, the largest of which are restricted to the sides of the arms of the head, diminishing in size within the invaginations. The sulcus is comparatively deep, bordered by fleshy margins; it divides dichotomously and the branches lead up into the respective invaginations.

Note: I am indebted to Col. Sir Sahib Singh Sokhey, Director of the Haffkine Institute for presenting me with a living specimen.

Sauria or Lizards.

In the *Fauna* (18) (vol. ii, Sauria) there is no mention either under the generic nor specific heads of the structure of the hemipenis in lizards beyond the general description given in the Introduction, already referred to. Evidently there has been no serious attempt at a classification based on the morphological characters of the hemipenis in the case of lizards as has been done in the case of snakes. However, after an examination of the limited material in my collection, it is clear that there is just as great a diversity in the morphological structure of the organ in this group as is exhibited in the snakes. For the purposes of comparison I have illustrated four types from four families, namely, *Gekkonidae, Agamidae, Chamaeleonidae,* and *Scincidae.* Very probably a further study of the subject will reveal that there are also differentiating characters between the genera and, perhaps, species, but here I must leave the subject.

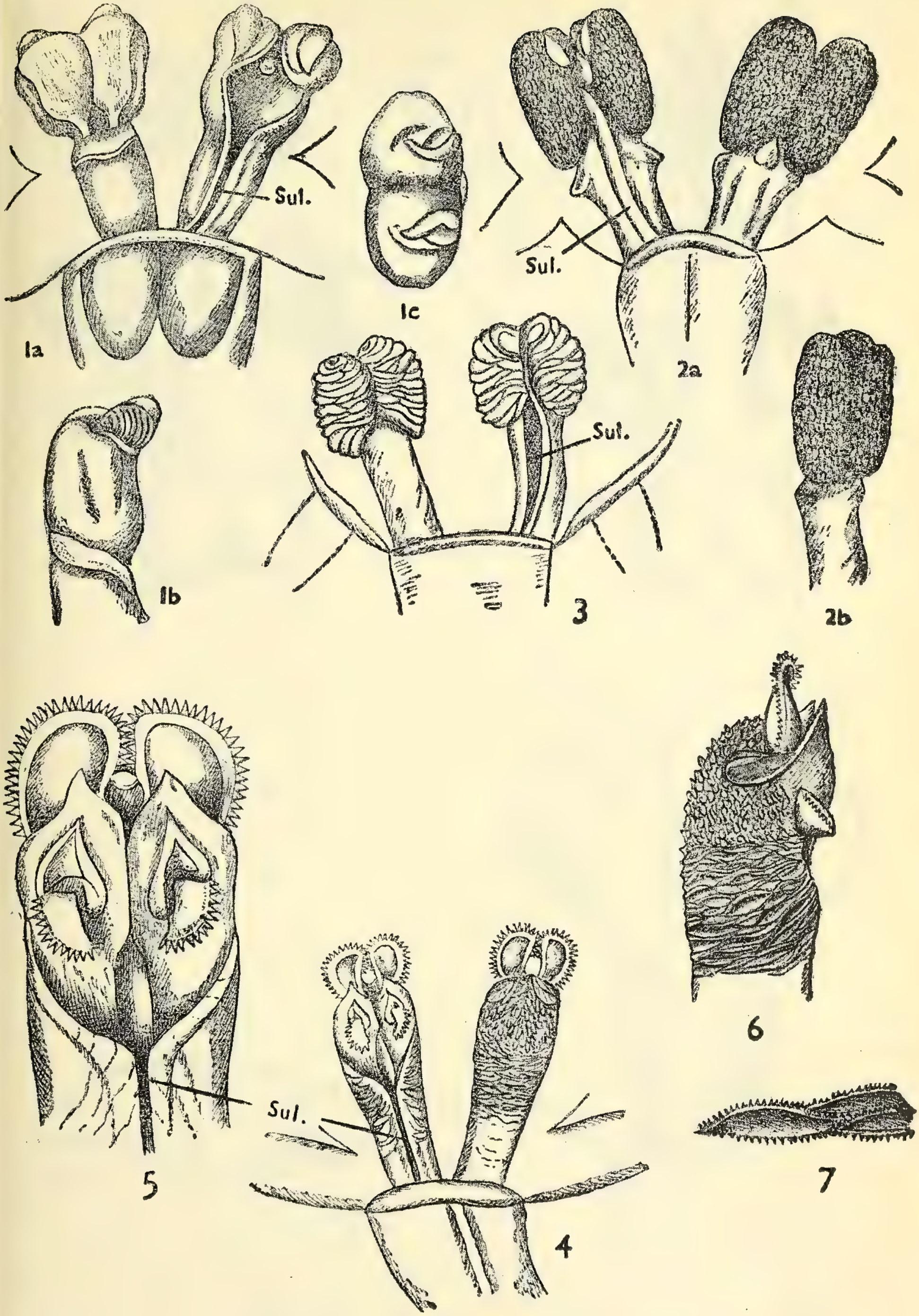
GEKKONIDAE.

Hemidactylus maculatus Smith. (Pl. IX, figs. D. E.).

Everted aspect: In the everted condition the pedicil and head are well defined. The pedicil is longer than the head; it is stout and is encircled by a thick, fleshy collar just below the head on the side opposite to the sulcus, the arms descending obliquely on the side of the sulcus where it descends to about the middle of the pedicil and its continuity is broken by the sulcus; the surface of the pedicil is smooth but a few fold lines are evident. The head is depressedly elliptical in outline and its surface is formed into several lobes; on the side opposite to the sulcus the lobes at the distal end are somewhat hemispherical; each lobe exhibits a cannaliculate depression at the top and a lateral ligulate excrescence; in the sinus between the lobes there is a somewhat rounded, elevated body; on the side of the sulcus the lobes are subdivided into minor lobes and elevations by a deep furrow; the surface of the head is marked with microscopic reticulations. The sulcus is deep, it opens out into a funnel-shaped depression distally, the sulcus is bordered by thick, fleshy margins.

Hemidactylus brookii Gray. (Pl. IX, figs. A-C.)

Everted aspect: In the everted condition the pedicil and the head are not distinctly defined. The pedicil is approximately as long as the head; it appears smooth unless viewed with a powerful lens or microscope, and then it is observed to be minutely, reticulately honey-combed. The head is shallowly bifurcated and lobate; in general outline it appears rounded; on the side of the sulcus, but from within its widened distal extremity, arise two short 'columns' each supporting a minutely papillate, hemispherical head; the surface of the head, like the pedicil is minutely, reticulately honey-combed, the honey-combing being largest on the shoulders. The sulcus is comparatively deep, and widens distally into a funnel-shaped depression finally passing between the bifurcation formed between the hemispherical nodules.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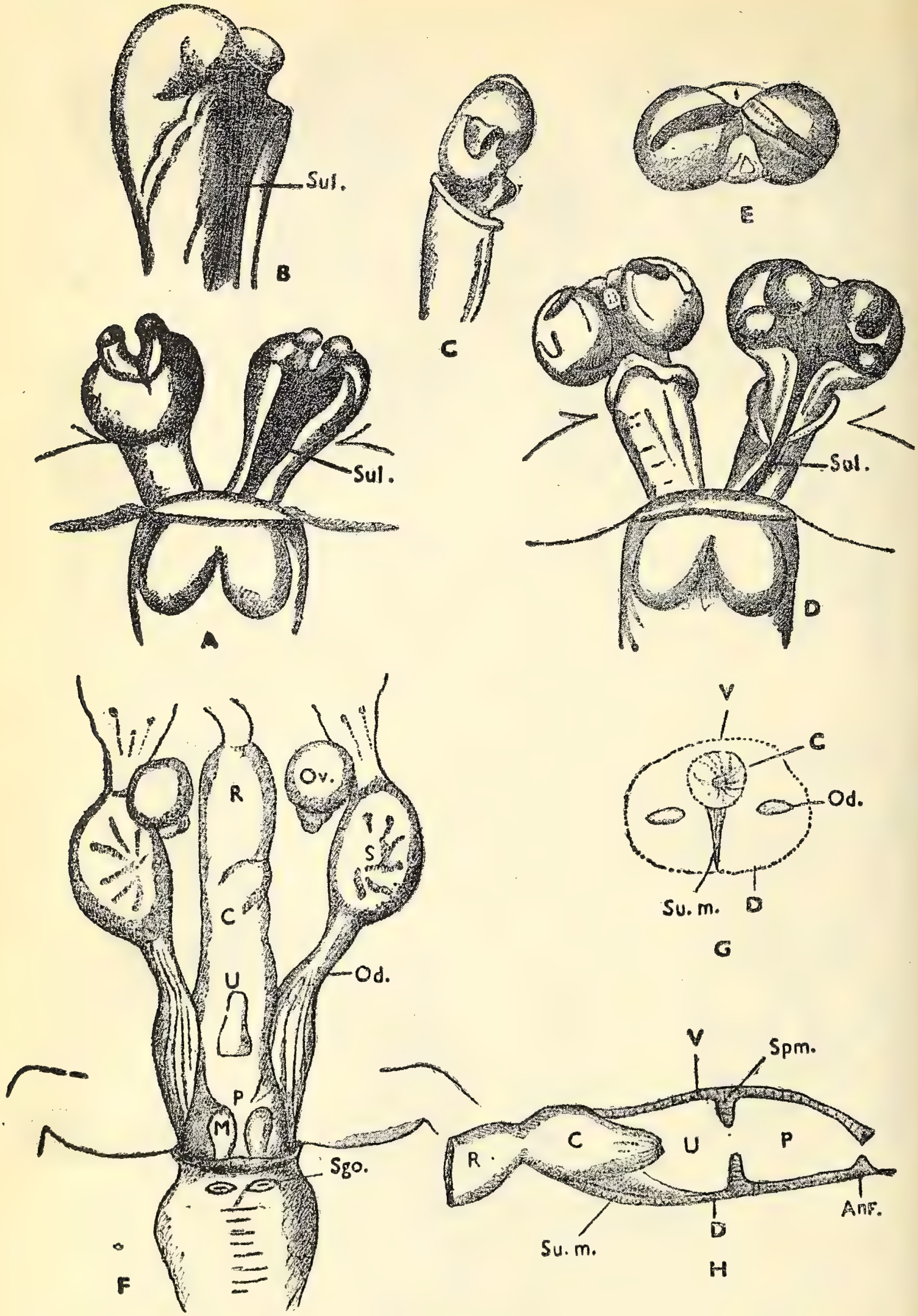
Del. C. McCann.

Hemipenes of Lizards.

1*a*, 1*b* & 1*c*, *Hemidactylus flavivirdis* Rüppell; 2*a* & 2*b*, *Calotes versicolor* (Daudin); 3, *Mabuya carinata* Boulenger. Sul., sulcus. 4-7, *Chamaeleon zeylanicus* Laurenti; 4, entire organ; 5, side of sulcus; 6, lateral view; 7, rugae.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Del. C. McCann.

Hemipenes and uro-genital system of **Hemidactylus.**

A-C, *Hemidactylus brookii* Gray ♂; D & E, *H. maculatus* (Dum. & Bibr.) Smith ♂; F-H, *maculatus*, ♀.

Anf., anal sphincter; C, coprodaeum; D, dorsal; M, musk gland; Od., oviduct; Ov., ovary; P, proctodaeum; R, rectum; S, shell gland; Sgo., opening of scent gland; Spm., sphincter membrane; Sul., sulcus; Su. m., suspension membrane; U, urodaeum; V, ventral.

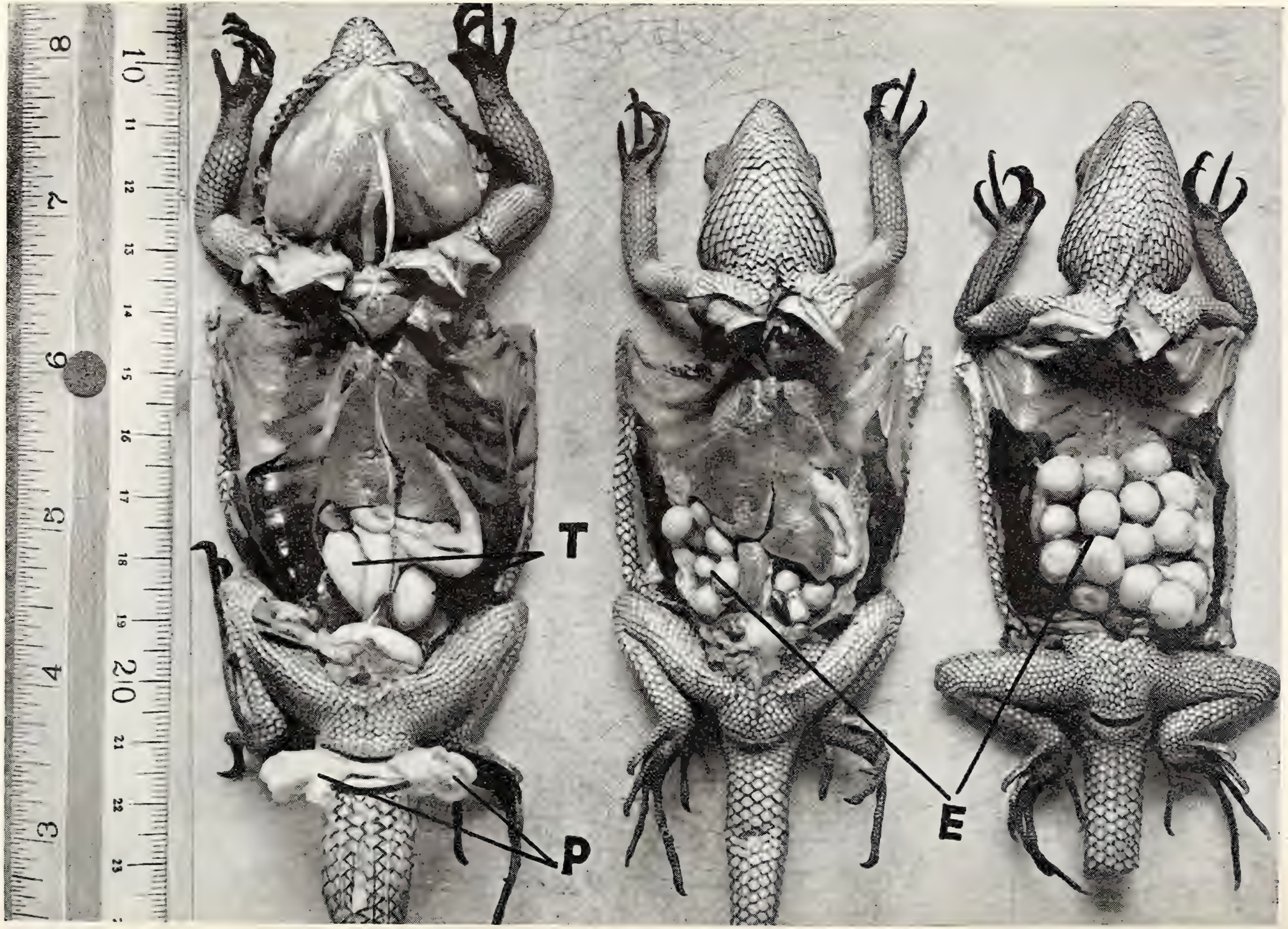
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PHOTO: C. MCCANN.

The Bloodsucker [*Calotes versicolor* (Daudin)] Dissections showing condition of the reproductive organs in June.

Hemidactylus flaviviridis Rueppell. (Pl. VIII, figs. 1a-1c).

Everted aspect: In the distended condition the pedicil and the head are fairly well demarcated. The pedicil is smooth, but minutely reticulately pitted under high magnification; on the side opposite to that of the sulcus, a transverse ridge is present just below the constriction between the pedicil and the head. The head is shallowly bifid and somewhat lobed; on the side bearing the sulcus the lobes are divided by a median thick tongue-like projection which is hollowed and furrowed on the outer side and rounded on the inner; between the lobes is a rounded elevated body; the side opposite that bearing the sulcus there are two obversely pear-shaped lobes on short 'pedicils'. The sulcus is deep and distally widens out into a funnel-shaped concaved area; the sulcus is bordered by somewhat thick margins.

AGAMIDAE.

Calotes versicolor (Daudin) Jerdon. (Pl. VIII, figs. 2a, 2b.) & (Pl. X).

Everted aspect: The hemipenis in this species is well developed. The pedicil is slightly shorter than the head; below the head, it is broadened out into two shallowly concaved shoulders; there are no spines. The head is somewhat triangular in transverse section, and is oblong in shape. It is shallowly divided longitudinally into four lobes, two being very slightly larger than the others. On the side of the sulcus there is a funnel-shaped opening on either side, and above, of which there are two smooth oval areas; on the side opposite the sulcus, there is a small, somewhat elevated disc, notched proximally, and situated just below the division between the two larger lobes of the head. The surface of the head is reticulatedly pitted, the pits being larger on the outside and diminishing in size towards the divisions between the lobes. The sulcus is comparatively deep and is covered by a flap formed by the fleshy enlargement of one of its margins. The sulcus leads into the funnel-shaped aperature already described which in turn is in communication with the sutures descending into the hollow formed by the union of the divisions of the head.

CHAMAELIONIDAE.

[1] **Chamaeleon zeylanicus** Laurenti. (Pl. VIII, figs. 4-7.).

Everted aspect: In the everted condition the hemipenis of the Chamaeleon is subcylindric with bearly any differentiation between pedicil and head. It is one of the most curiously formed organs I have so far observed and is difficult of accurate description on account of its complex structure. The pedicil is approximately as long as the head; in its lower half it is almost smooth; in the upper half it is partially encircled by rugose flounces, the margins of which are very minutely serrated; on the side of the sulcus the flounces pass into oblique ridges and folds. The top of the head is crowned by two erect crescentic plates with serrated margins; on the side of the sulcus there is a glottis-like structure just at the base of the two crescentic plates, the top margins of this structure are also minutely serrated; near the middle of the head are another two crescentic plates fixed transversely to the long axis of the organ, the margins of these plates are also serrate; on the side opposite to that of the sulcus the head is covered by reticulately honeycomb-like pits, the margins of each pit being minutely serrated. The sulcus is deep and is bordered by somewhat thick margins; at the base of the head it widen out into a funnel-like cavity under the two transverse plates; mesially there is a groove between the plates.

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[1] The *Fauna* (vol. 2,p. 251) attributes the generic name *Chamaeleon* to Gronovius (1763): in the *Catalogue of Lizards*, vol. 3, p. 438, the authority for the same name is Laurenti (1768). According to the *Fauna* Laurenti used the name *Chamaeleo zeylanicus*. The spelling of the generic name is at variance, and, I believe, according to the Rules the authority for the new combination *Chamaeleon zeylanicus* should read (Laurenti) Smith, not merely Laurenti, but as I have no access to the Rules I merely raise this point out of interest.

SCINCIDAE.

Mabuya carinata (Schneider). (Pl. VIII, fig. 3.)

Everted aspect: In *M. carinata* the hemipenis is less complicated than in *Calotes*. The pedicil is well demarcated; it is columnar and without any spines or excresences. The head is somewhat turban-like; on the side of the sulcus it exhibits two large, obliquely ovate elevations divided from each other by a shallow suture, the continuation of the sulcus; the surface is thrown into oblique, fleshy, turban-like folds and ridges. The sulcus is deep with one margin developed into a fleshy flap; it divides the head into two halves and terminated between the two large lobes at the distal extremity, already referred to.

CONCLUSION.

After paying much attention to the breeding of reptiles in the field, and studying such literature as is available to me, it is evident that little attention has been paid to the morphological characters of the hemipenis of Indian reptiles in the fresh and everted condition. The study of breeding habits, like the study of any other aspect of animal life, always leads one into a maze of ramifications. At this point the student is confounded, for no matter which path he follows he must know, or try to know, the geography of the others as they are inseparably interconnected. After years of work in the field, I have found myself at this point. To study breeding without the study of the genitalia, mode of coitus in the different groups, and other aspects, seemed to me to be incomplete. The present paper has been born out of a desire to put on record my limited anatomical studies and observations. I fully realize that the subject, as I have presented it, is very incomplete and that there is much room for further study, but for lack of time and facilities I cannot pursue the subject further.

Many of the conclusions I have drawn may perhaps, at first sight, appear rather gratuitous, but in the absence of positive fact these were the only reasoned conclusions I could arrive at after weighing each detail in all its aspects in relation to the animal behaviour and such field observations as were possible.

However, one point really emerges from this scrappy account, namely, that the study of the copulatory organs should be undertaken from specially prepared material and their structure studied in the fully everted position, and not merely described from material dissected out of old spirit specimens. Such descriptions, though they may be useful, leave much to be desired. Dissected-out preserved specimens do not lend themselves to accurate description, and give us no idea of the organs in the fully everted state, which, to my mind, is the more correct aspect. This point is clearly illustrated by a comparison of the photographs and drawings accompanying this article with those reproduced in the *Fauna* (22) and elsewhere. If this article only serves as a stimulant to some other student to pursue the subject more fully than I have been able to do, it will have served a useful purpose and justified its publication in spite of its shortcomings.

In my opinion the paired copulatory organs met with in snakes and lizards should be taken together as representing two halves of a *single organ* adapted to the anatomical structure and habits of such animals as possess them, and not as two distinct organs capable of operating independently of one another. The dual structure, besides forming a passage for the conduction of the seminal fluid, functions as an *internal* copulatory hold during coitus. This in itself appears to be a very significant point and accordingly I cannot accept the statement that only one-half of the organ is inserted at a time, for reasons which I have explained at length above.

There is definitely a possibility of utilizing the penial characters as a means of classification, particularly when dealing with families and genera, but its use for specification must be left for further investigation and comparison of especially prepared material. However, there is perhaps one serious difficulty to this form of specific classification, namely, How are we to assign females to their correct species? This difficulty was experienced by the Popes when dealing with the genus *Trimeresurus* and is repeated in the *Fauna* (22). One species of this genus, at least, rests on a single known female (*T. kanburiensis*)! The remainder were separated on penial characters. Although there may possibly be subtle characters observable in females, so far I have failed to record any with the limited material at my disposal. However, I feel that as this form of classification implies dissection of the specimens under investigation, it is very undesirable as it means the possible ruin of the specimens in the long run, more so as it would have to be applied to all material in existing collections, some of which are undoubtedly already in a precarious state of preservation due to long storage and frequent handling. Another point that militates against an accurate description of the female cloaca is its unstable condition owing to the physiological changes which take place from the active to the inactive periods of the gonads. Although similar changes take place in the males the hemipenes do not undergo any alteration in characters in or out of season.

A point worthy of mention in the study of the hemipenis in reptiles is the transition observable from the completely divided organ in snakes and lizards with its sulci to the single solid organ with its groove in Crocodiles and Chelonians to the completely tubular, erectile penis in the higher animals (Mammals). However, this point of the possible evolutionary aspect is beyond the scope of this paper.

Appendix.

How to sex a snake: Some snakes exhibit sexual dimorphism, but these instances are few, and are only recognised after long experience. The comparative difference in the length of the tail between the sexes is at times helpful but is not infallible. In males the area just below the vent is somewhat 'spongy' owing to the presence of the hemipenis, but in unpractised hands may lead to a mistaken determination. Pressure at the base of the tail may result in the eversion of the hemipenis, in such cases the evidence is conclusive. Apart from actual dessication, and the application of pressure, the only *sure* way of sexing a snake is as follows:

Having secured the head (if a living animal is being examined), push the anal shield foreward (towards the head) and press on the tail between the 1st and 3rd caudal shields at the same time drawing them downwards. This procedure widens the opening of the vent and occasionally exposes the point at which the hemipenis is invaginated. The seat of the invagination is often marked by a slight discolouring at the point of retraction. This area may be greyish, blackish or purplish. With a blunt probe gently probe in the area; if a male the probe will sink into the reverted hemipenis to the full depth of the organ which is a sure sign of the animal's sex. It is obvious that this will not occur in females—the organs are absent. An ordinary match stick will serve the purpose of a probe if one is not available.

[1]*Methods used in preservation.* After killing the animal cut off the body a couple of inches or so above the vent, if the complete specimen is not required, or, keep the head with the tail for purposes of identification. Pressure applied an inch or so behind the vent, according to the size of the snake, will usually induce the eversion of one or both halves of the hemipenis. The firmer the pressure the better. In some snakes this procedure is a little more difficult than it appears. The next thing is to take a syringe with a hypodermic needle (No. 16 or 18) filled with 4% formalin and insert the needle at the base of the organ through the scales—the

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[1] I discussed, with Dr. H. R. Rishworth, O.B.E., F.R.C.S., D.Ph., J.P., C.B.E., the injection method adopted by me for obtaining the everted positions of my specimens; and he was of the opinion that as I did not inject the fluid into the arteries a certain amount of distortion may have taken place due to intracellular infiltration. This point did not strike me at the time, but is certainly one to be remembered in future. However, there are difficulties when not working under laboratory conditions and when time is a consideration in in the field.

distance below the vent varies with the size of the organ, or if already everted, the degree to which it is everted. Pump in the liquid carefully till the greater part of the hemipenis is visible; now tie a loose knot around the base of the pedicil in readiness to be tightened as soon as the hemipenis is fully everted by a further injection of fluid. If it becomes necessary to fill the syringe once more before the operation is completed, do not remove the nozzle, the fewer the holes the better, or else the liquid oozes out before the organ sets. When the hemipenis is fully distended withdraw the needle carefully at the same time tightening the knot firmly to prevent escape of the liquid. A little practice is needed before success is achieved. It is advisable to add a little Bouin's fluid to the formalin as this helps to harden the tissues more rapidly. When the organ is fully distended coat the outside also with Bouin's fluid. Having got so far, put the specimen aside to harden before immersing it in formalin for final preservation. It must be carefully watched during fixing to see that there is no serious retraction. If necessary a little more fluid can be carefully injected.

The same end may be achieved by means of a blow-pipe but this method is not so satisfactory as the fluid process.

If the hemipenes do not evert by injection they may be carefully drawn out by means of a pair of forceps and the thumb kept pressed behind to prevent it retracting. When the organ has been partially drawn out in this way employ the injection method. Specimens preserved in this manner keep well. This method may of course be improved upon.

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BUTTERFLIES OF KAIRA DISTRICT—A LIST.

BY

HERSCHEL C. ALDRICH, M.D.

There is no published list of butterflies for Kaira District. Such a list may be of some value in fixing more exactly the distribution and range of butterflies as a whole in western India. The list will also be of interest to anyone who may be collecting in this area.

The following lists have been published for the nearest areas or localities surrounding Kaira District:—

(1) Jodhpur and Mount Abu (the latter is 140 miles, in a direct line, north of Nadiad, the centre of Kaira District). By A. D. Macpherson, in the *Journal of the Bombay Nat. Hist. Soc.*, Vol. xxxii, No. 1 (1927). 63 species are listed.

(2) Mhow (200 miles east of Nadiad). By Swinhoe in the *Proceedings of the Zoological Society* for 1886.

(3) Konkan (the northern limits of this area are given as Surat which is about 100 miles directly south of Nadiad). By E. H. Aitken and E. Comber in the *Journal of the Bombay Nat. Hist. Soc.*, Vol. xv, No. 1 (1903). 130 species are listed.

(4) Kathiawar, with special reference to Bhavnagar State (Bhavnagar is 80 miles south-west of Nadiad). By A. H. Mosse in the *Journal of the Bombay Nat. Hist. Soc.*, Vol. xxxiii, No. 4 (1928). 75 species are listed.

(5) Cutch (200 miles west of Nadiad). By C. G. Nurse in the *Journal of the Bombay Nat. Hist. Soc.*, Vol. xii (1900). 46 species are listed.

A comparison of these lists with ours for Kaira District is of special interest for the following species:—

Colotis protractus But. is not listed to the south-west in Bhavnagar, nor to the south in the Konkan. This would fix the south-western limit of this species along the coast of western India, in Kaira District.

Neptis hylas varmona M. is not listed to the south-west in Bhavnagar, nor to the west or north of Kaira District. The north-western limit of this species may be in the neighbourhood of Kaira District.

Telchinia violoe, Fab. is listed to the south-west and south of Kaira, but not to the west or north. The Kaira list may therefore fix its north-western coastal limit.

The butterflies here listed for Kaira District represent a collection made from December 1941 to December 1944. The collecting has been done fairly systematically and regularly by hand-net; no eggs or larvae have been collected. Most of the collecting has been in the centre of Kaira District, in and around Nadiad. The western half of the district has also been fairly well covered. The eastern half of the district has only been collected in spots and may produce a few more species. As no further new species have been added to our list during the past year, it is probable that this list of fifty-nine different species includes all of the butterflies ordinarily found in the district. With more careful collecting the number of *Lycaenidae* and *Hesperiidae* might be increased. The nomenclature followed in our list is that of W. H. Evans in his book, *Identification of Indian Butterflies*, second edition revised. The numbers preceding each butterfly listed are those found in Evans' book, and are given for reference.

A. PAPILIONIDAE.

A2. 10. β. **Tros aristolochiae aristolochiae,** F. Fairy common in occurrence throughout the district.

A4. 1. β. **Papilio polymnester polymnester,** Cr. Rare. Two were seen in a garden in Nadiad on the 24th. of December 1944; one of these was collected; a male. This species is not listed to the north, west, or south-west of Kaira District. In all probability the north-western limit of this species along the coast of India is in Kaira District.

A4. 25. α. **Papilio polytes romulus,** Cr. Fairly common. The first or 'Typical Form' of female resembling hector, as described in Evens, is uncommon. The 'Second Form', resembling the male, has not been collected here in Kaira. The 'Third Form', resembling aristolochiae, is the common form of female seen.

A4. 27. α. **Papilio demoleus demoleus,** L. Common.

A6. 8. α. **Zetides agammemnon menides,** Fruh. Rare. During October and November a few are seen in gardens.

B. PIERIDAE.

B6. 3. **Delias eucharis,** Drury. Fairly common.

B8. 1. β. **Belenois mesentina mesentina,** Cr. Common.

B9. 2. α. **Huphina nerissa evagete,** Cr. Common during October, November and December.

B10. 4. α. **Appias libythea libythea,** F. Not rare during November and December.

B11. 1. **Catopsilia crocale,** Cr. Common.

B11. 2. **Catopsilia pomona,** F. Common.

B11. 4. **Catopsilia pyranthe minna,** Herbst. Very common.

B11. 5. **Catopsilia florella gnoma,** F. Fairly common.

B15. 1. **Terias libythea** F. Fairly common.

B15. 2. α. **Terias laeta laeta,** Bdv. Common.

B15. 5. **Terias hecabe simulata,** M. Very common.

B17. 1. **Ixias marianne,** Cr. Common.

B18. 1. β. **Colotis amata amata,** F. Very common; especially along hedges of Salvadora persica. The next three species of Colotis are also found more frequently along hedges of Salvadora persica, or in the neighbourhood of this plant.

B18. 2. **Colotis protractus,** But. Rare; only found very locally on Salvadora persica, in one or two restricted areas in the south-west corner of the district. Collected in December and January. (See note in introduction on the distribution of this species.)

B18. 3. **Colotis vestalis,** But. Common.

B18. 4. β. **Colotis fausta fausta,** Oliv. Not rare.

B18. 5. β. **Colotis etrida etrida,** Bdv. Common.

B18. 7. α. **Colotis danae danae,** F. Common.

C. DANAIDAE.

C2. 9. **Danais limniace mutina,** Fruh. Fairly common during the rains; rarely seen after October.

C2. 12. **Danais plexippus,** L. Rare; seen occasionally in some years only, during August and September.

C2. 15. **Danais chrysippus,** L. Very common; this is one of the commonest butterflies seen throughout the year.

C3. 7. β. **Euploea core core,** Cr. Common during the rains. The first are seen towards the end of July; they are common throughout August and September, and become scarce in October.

D. SATYRIDAE.

D22. 1. **Melanitis leda ismene,** Cr. Rather scarce. A few are to be seen during September, October, November and December. Commonest perhaps in October.

F. NYMPHALIDAE.

F1. 7. β. **Charaxes fabius fabius,** F. Rare. One ♀ collected 6-3-45. This is the only specimen seen or collected by me in Kaira District.

F26. 6. α. **Neptis hylas varmona,** M. Rare; only seen on one occasion early in November 1943. At this time seven specimens were seen, of which four were collected. (See note in introduction to this list, on distribution of this species.)

F30. 1. **Hypolimnas misippus,** L. Fairly common.

F30. 2. **Hypolimnas bolina,** L. Rather scarce; seen during September, October, and November. Very quick to take cover if molested. Females predominate; have only seen one male of this species in the district.

F35. 1. α. **Precis hierta hierta,** F. Rather scarce and somewhat local in its distributation. Seen in October and November.

F35. 2. α. **Precis orithya swinhoei,** But. Very common.

F35. 3. α. **Precis lemonias vaisya,** Fruh. Common.

F35. 4. α. **Precis almana almana,** L. Common in October.

F36. 1. **Vanessa cardui,** L. Common.

F52. **Telchinia violoe,** Fab. Rare; seen in fairly large numbers, locally in south west corner of the district on Indigofera during September in 1943 only. One freshy emerged specimen collected Feb. 8, 1944, and one December 13, 1944. The rainfall in Gujerat has varied a good deal in the past four or five years. Up till 1943 it had been well below average for some four years. (See note in introduction on the distribution of this species.)

H. LYCAENIDAE.

H12. 6. **Tarucus extricatus,** But. Not rare.

H13. 1. **Syntarucus plinius,** F. Common.

H14. 1. **Azanus ubaldus,** Cr. Common.

H14. 2. **Azanus uranus,** But. Common.

H14. 4. **Azanus jesous gamra,** Led. Not rare.

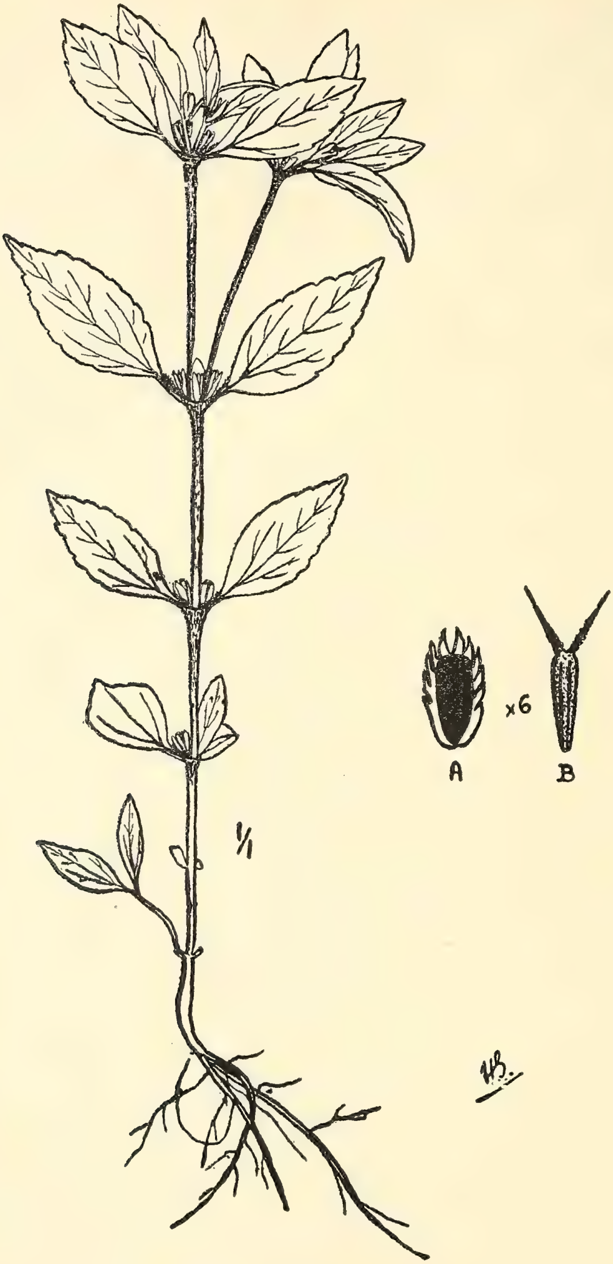
H23. 1. α. **Chilades laius laius,** Cr. Common.

H24. 1. α. **Zizeeria trochilus, putli,** Koll. Common.

H24. 4. **Zizeeria lysimon,** Hub. Common.

H24. 6. α. **Zizeeria otis decreta,** But. Common.

H25. 1. **Euchrysops cnejus,** F. Common.



Synedrella nodiflora Gaertn.

A. achene of ray floret; B. achene of disc floret.

H25. 2. β. **Euchrysops contracta contracta,** But. Common.

H27. 1. **Catachrysops strabo,** F. Common.

H28. 1. **Lampides boeticus,** L. Common.

H29. 1. α. **Jamides bochus bochus,** Cr. Not rare.

H57. 6. β. **Spindasis ictis ictis,** Hew. Not rare; seen commonly in November.

H84. 1. **Virachola isocrates,** F. Not rare. Locally distributed.

H85. 16. **Rapala melampus,** Cr. Rare. Only three seen; two of which were caught. (18 Dec. 1943, 28 Nov. 1944, and 14 Dec. 1944).

I. HESPERIIDAE.

I1. 16. **Hasora aloxis alexis,** F. Rare.

I97. 24. α. **Baoris conjuncta narooa,** M. Rare.

I97. 31. β. **Baoris mathias mathias,** F. Common.

I98. 1. β. **Gegenes nostrodamus karsana,** M. Scarce.

Nadiad,
Kaira District.
Dec. 1, 1944.

NEW PLANT RECORDS FOR THE PRESIDENCY OF BOMBAY (II).

BY

FR. H. SANTAPAU, S.J.

(*With a plate*)

In this second set of New Records,[1] I have selected mainly a number of plants from N. Kanara. For the description of the plants, I have consulted Hooker's *Flora of British India*, D Candole's *Prodromus*, Gamble's *Flora of the Presidency of Madras*, and, in the case of *Gomphostemma Heyneanum* Wall, Mukerjee's *Labiatae of the Indian Empire*. Their descriptions have been supplemented from study of the specimens in Blatter Herbarium.

1. **Synedrella nodiflora** Gaertn. *Fruct.*, ii, 456, t. 171, f. 7; D C. *Prodr.*, v, 629; Hook., *Exot. Fl.*, t. 60; Clarke, *Comp. Ind.*, 139; Hooker, *f. Fl. Brit. Ind.*, iii, 308; Gamble, *Fl. Pres. Madr.* 708; Mayuranathan, *Fl. Plants Madr., City*, 153.

Synedrella belongs to the family *Compositae*, and is placed by Hooker under Tribe V *Helianthoideae*, subtribe 6 *Coreopsideae*.

Annual, erect herb, branching dichotomously and reaching a height of about 60 cm.; stems and branches finely striate, terete, glabrous or more or less hairy with whitish appressed hairs, which are more dense just below the nodes.

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[1] See *J.,B.N.H.S.*, vol. 45, p. 445.

Leaves opposite, ovate-lanceolate, tapering at both ends, serrate or crenate, scaberulous with a few scattered hairs on both sides; base decurrent into the petiole; petioles about 8 mm. long, but often obscure on account of the decurrent leaf blade. Nerves 3 from the base or near it, with about 4—6 pairs of fainter ones higher up. The bases of the petioles of opposite leaves meet round the stem and form a sort of a stipular cup, which is densely hairy with stiff white hairs and ciliate.

Involucres ovoid; bracts few, the outermost herbaceous, densely hairy; the inner ones passing gradually into the paleae of the receptacle, shining, yellowish. Receptacle small, flat. Floral heads in the axils of leaves, at the nodes between two dichotomous branches and at the end of the branches, sessile or nearly so, a few heads generally crowded together.

Florets yellow; outer florets ligulate, fertile, female, ligule short, broad, 2-3-toothed; disc florets hermaphrodite, fertile, tubular, limb 4-toothed. Both ligulate and tubular florets are of about the same size, so that the ligules are easily missed. Anthers black, subentire at the base, half-exerted. Style arms of hermaphrodite florets with long acute tips.

Achenes of ray florets dorsally compressed, 2-winged, smooth, wings irregularly cut unto a number of teeth which are hairy or pubescent (see plate, fig. A.); the achenes are black, the wings and teeth greenish yellow. Achenes of the disc florets narrower, striate, muricate, ending in two stiff, spreading hairy spines, which are as long as or a little shorter than the achenes (see plate, fig. B.)

This seems to be a Central American plant, which has been introduced into India in cultivated lands. Gamble, loc. cit., gives it as a plant of 'Plains Districts, occasional on cultivated lands, introduced from Mexico '. Mayuranathan, loc. cit., mentions that 'this weed is thoroughly naturalized here and is frequently found on waste land '. I have been unable to find any other reference to the plant in any other published floras on India.

In the Blatter Herbarium there is a specimen collected by Sedgwick (Sedg. 2952!) during September 1917 at Belgaum; a note in the handwriting of Sedgwick mentions that the plant is 'well established at Belgaum in the Fort and in compounds '. Recently I found this plant growing abundantly at Jogeshwari near Bombay (Santapau 8161, 8162); it was a gregarious plant, generally growing under the shade of trees, though it seemed to thrive best at some distance from the trunk of the protecting tree. (See pl.).

2. **Salomonia oblongifolia** DC. *Prodr.*, i 354; Bennett in Hooker *f. Fl. Brit. Ind.*, i, 207, *S. obovata* Wight Ill., i, 49, t. 22 B; *S. leptostachya* Wall. Cat. 4193.

Salomonia belongs to the family *Polygalaceae;* Cooke mentions only *Polygala*, Blatter in his Revision (Part XII, in this *Journal*, vol. 34, No. 2, p. 302, July 15, 1930) adds a new genus, *Xanthophyllum*. I add the genus *Salomonia*, which on the testimony of T.R.D.Bell is common in N. Kanara.

Simple or branched annual herb. Stems erect, glabrous, furrowed and slightly winged, 6-30 cm. high.

Leaves elliptic or ovate-lanceolate, sessile or very shortly petiolate, base acute not cordate, margins entire and with a few long distant hairs; mid-nerve strong, other nerves obscure. Stipules O.

Flowers minute in dense terminal spikes; bracts linear, minute, often persistent at the time of flowering. Flowers crowded, minute, 2-3 mm. in length, generally pink, occasionally white (Blatt. Herb. No. 35146). Spikes 1.5-4 cm. long.

Sepals 5, nearly equal, lanceolate, slightly ciliate, the 2 interior somewhat larger. Petals 3, united below with the staminal tube, the inferior petal keel-shaped, galeate, not crested; lateral petals much shorter than the keel. Stamens 4-5, filaments united below into a tube or sheath; anthers opening by pores. Ovary 2-celled, each cell with one pendulous ovule. Capsule much compressed laterally, 2-celled, loculicidal, margins with a row of long teeth, which are red or reddish in colour. Seeds albuminous, black, shining, not strophiolate.

This species is very near *S. ciliata* DC., from which it differs mainly in the shape and structure of the leaves; in *S. ciliata* leaves are amplexicaul, cordate, sessile and strongly ciliate.

To the localities given in *Fl. Br. Ind.*, North Kanara must be added. In the Blatter Herbarium there are several specimens collected during the month of October 1919 in various places of North Kanara: Hallb. and McCann, 35083, Jod-Siddhapur; 35146, Sampakhand; T.R.D.Bell, 4234, grass lands at Sulgeri on the Kala Nadi; L. J. Sedgwick 6656, grass banks by the sea, Karwar; Sedgwick and Bell 7254, Siddhapur. All these specimens show flowers and fruits; the upper part of the spikes is in flower, the lower in fruit, and most of the fruits are dehisced.

3. **Gomphostemma Heyneanum** Wall. Cat. 2152/I and 2152/B; DC. *Prodr.*, xii, 551; Wight Ic. t. 1456; Prain in *Ann. R.B.G.Cal.*, iii, 248 and t. 79; Gamble, *Fl. Madr.*, 1157; Mukerjee, *Lab. Ind. Emp.*, *Rec. Bot. Surv. Ind.*, xiv, 206; *G. strobilinum* var. *Heyneana* Hook. f. *Fl. Brit. Ind.*, iv, 696.

Gomphostemma belongs to the family *Labiatae*, and is placed by Mukerjee in Tribe VI, *Prasieae*. The following description is taken from Mukerjee, loc. cit.:

'Tall robust subshrubby herb, 60-100 cm. high; stem erect, obtusely tetragonous, slightly grooved, densely tomentose with stellate hairs. Leaves petiolate, elliptic-ovate, subacute, closely serrate, base abruptely cuneate and decurring on the petiole; lamina 16-24 cm. long, slightly rugose and shortly hirsute above, flocculently tomentose beneath; petiole 4 cm. long. Spikes terminal, interrupted near the base; bracts ovate or ovate-lanceolate, acute, rounded at the base, longer than the calyx; bracteoles linear. Calyx about 11 mm. long, teeth shorter than the tube, lanceolate, acuminate. Corolla yellow or blue with purple tinge, 12-15 mm. long, tube as long as the calyx, slightly incurved above, hirsute in the middle within; mouth broad, upper lip short, tomentose. Style glabrous. Nutlets 5 mm. long, black, rugose, glabrous.'

In the Blatter Herbarium there are several specimens of this plant, all of which have been collected in North Kanara round about Gersoppa Falls; No. 35076 was collected by Hallberg and

McCann in October 1919; Sedgwick collected Nos. 7062 and 7235/I, 7235/II, 7235/III in October 1918. All these Herbarium sheets bear remarks by the collectors showing that in every case the flowers were bright yellow. Prain, loc. cit., gives Stocks as the authority stating that the plant is found in the Konkan; I have been unable to trace this reference; neither Hooker *f.* nor Mukerjee mention Stocks as having found the plant in the Konkan; there are no specimens from the Konkan in Blatter Herbarium.

For a fine plate of this plant, see Prain, loc. cit., plate no. 79.

4. **Euphorbia prostrata** Ait. *Hort. Kew.* ii, 139; Hooker *f. Fl. Br. Ind.*, v, 266C not *E. prostrata* Grah., which is a synonym for *E. thymyfolia* Burm).

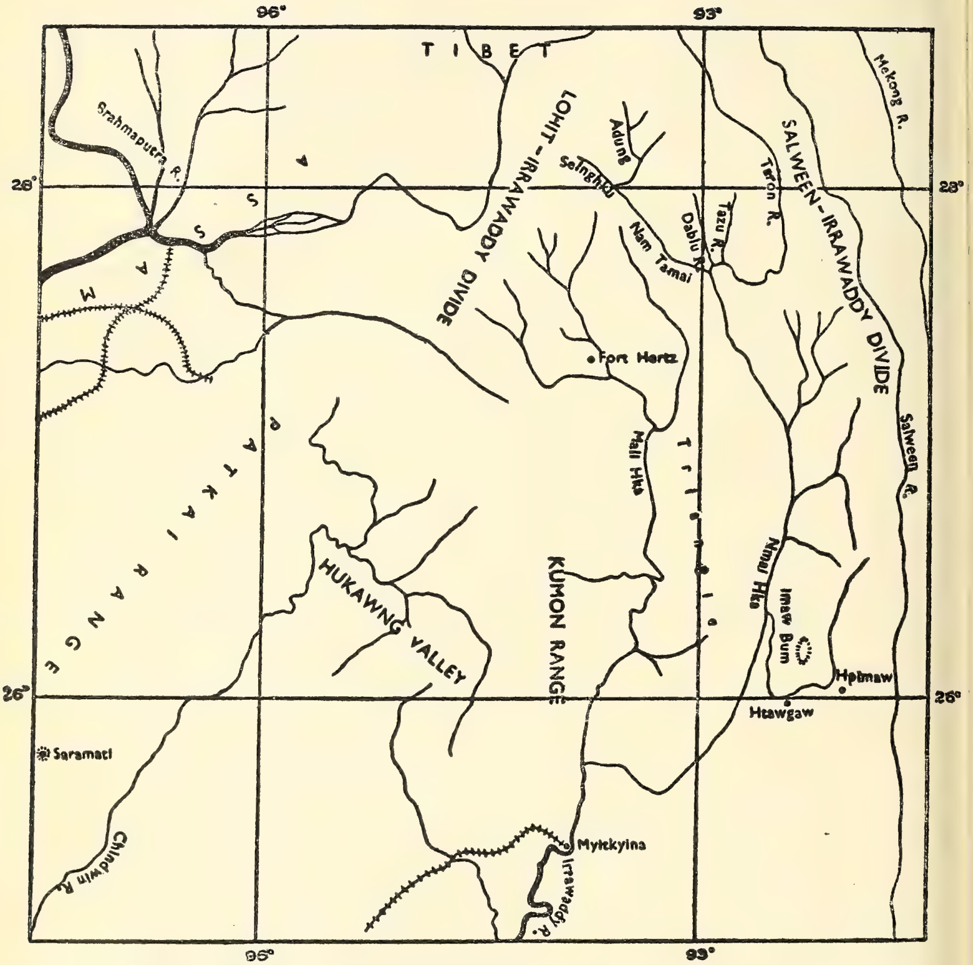
J. D. Hooker in his *Fl. Brit. Ind.*, loc. cit., places this species at the end of his Euphorbias, under the heading 'Doubtful Species'. He adds the following remarks: 'Englemann (in Torrey, *Bot. Mex. Bound. Exped.*) says of this American species that it is found in India; but I have seen no specimen, nor does Boissier, who figures it well (*Euphorb.* Ic. t. 17), mention it as Indian. It is a native of W. Africa and the Mauritius. It closely resembles *E. microphylla*, differing in the ciliate keel of the cocci.'

In Blatter Herbarium there are three specimens collected by M. Ezechiel at Poona on the 17th and 21st of may 1917 and identified by the collector as *E. thymifolia* Burm.; the identification of these three specimens (13509, 13509/B, 13510) has been corrected by Blatter, who adds the following remarks: 'Cocci ciliate especially the keels'. Gamble, *Fl. Pres. Madr.*, p. 1276, notes: '*Euphorbia prostrata* Ait . . . . Deccan and Carnatic, occasionally, usually probably as a weed in gardens. An introduced plant, native of W. Indies. A Prostrate herb.' On the evidence of Gamble and of the specimens in Blatter Herbarium, there is, therefore, no doubt as to the occurrence of this plant in India in general and in Bombay Presidency in particular.

5. **Isanthera permollis** Nees in *Trans. Linn. Soc.*, xvii, 82; DC. *Prodr.*, ix, 279; Wight Ic. t. 1355; Clarke in *Hooker's Fl. Brit. Ind.*, iv, 372.

This plant belongs to the family *Gesneraceae*.

Small undershrubs; stems in the Kanara specimens 10-20 cm. high, up to 6 mm. thick, woody, covered with leaf scars almost from the base. Leaves alternate, broadly oblanceolate, tapering at both ends, entire or nearly so, with slightly revolute margins; up to 15 x 6 cm.; base decurrent into the petiole; petioles 0.6—3 cm. long. Nerves about 12-14 pairs, very distinct on the under surface of the leaves. Leaves, when young, densely silky pubescent with reddish hairs; at length glabrous or nearly so above, more or less pubescent beneath. Inflorescence cymose, axillary, towards the end of the stem; whole inflorescence densely silky pubescent, at length more or less glabrous. Peduncles about as long as the petioles, the whole cyme 1.5-4.5 cm. in diam. Bracts narrow, acute, up to 9 mm. long. Sepals 5, small, narrow, 4-6 mm. long, silky, at length glabrous. Corolla small, shortly campanulate, obscurely 2-lipped; lobes 5, ovate, white. Stamens 4, fertile; filaments short, anthers small, subquadrate, 2-celled, slits marginal, finally confluent at the subemarginate apex. Disc very small or O.


96°
93°
28°
28°
26°
26°
96°
93°
TIBET
Brahmaputra R.
ASSAM
LOHIT-IRRAWADDY DIVIDE
Adung
Seinghku
Nam Tamai
Dablu R.
Tazu R.
Taron R.
SALWEEN-IRRAWADDY DIVIDE
Mekong R.
Fort Hertz
Mali Hka
Triangle
Nmai Hka
Imaw Bum
Hpimaw
Htawgaw
Salween R.
PATKAI RANGE
HUKAWNG VALLEY
KUMON RANGE
Saramati
Chindwin R.
Myitkyina
Irrawaddy R.

Map of Upper Burma.

Ovary ovoid, sessile; style shorter than the ovary, stigma small, simple, ovary glabrous, muriculate.

Fruit a berry, small ovoid, 8×4 mm., fleshy, indehiscent. Seeds very small, ellipsoid, smooth, brown in colour.

Collected by Hallberg and McCann near Gersoppa Falls, North Kanara in October 1919 (Nos. 34758, 35050, 35053). Sedgwick and Bell collected it in the same month and year at Malemane Ghat in North Kanara (Nos. 7208/I, 7208/II).

6. **Microcarpaea muscosa** Br. *Prodr.* 436; Benth, in DC. *Prodr.*, x, 433; Gamble, *Fl. Pres. Madr.*, 963; Hooker in *Fl. Brit. Ind.* iv. 286.

This plant belongs to the family *Scrophulariaceae*, and the genus is not mentioned in Cooke as occurring in the Presidency.

A very small slender, diffuse or creeping nearly glabrous herb. Stems tufted and interlaced, 6-12 cm. long, rooting at the nodes, angles of the stem and calyx sometimes ciliate.

Leaves opposite, sessile, oblong, obtuse, entire, 3-8 mm. long. Flowers minute, axillary, solitary, sessile, ebracteate, in one axil only of each pair of leaves, about 2-3 mm. long. Calyx tubular 5-angled, 5-fid. Corolla very short, tube broad; lobes 5, spreading, the 2 upper lobes subconnate; tube shorter than the calyx. Stamens 2 perfect, filaments filiform; anthers confluent, 1-celled; staminodes O. Style filiform, stigma capitate, recurved. Capsule minute, included, ovoid, 2-grooved, loculicidal; valves entire, separating from the placentiferous septum. Seeds few, ovoid.

To the localities given in Hooker's Flora must be added those given by Gamble: 'W. Coast, S. Canara to Travancore in marshy places.' In the Blatter Herbarium I have seen the following specimens: No. 34345, collected by Hallberg and McCann at Karwar, N. Kanara during the month of October 1919; Sedgwick 5123, collected by Sedgwick in a rice field at Karwar in December 1918, and Sedg. 7256 collected by Sedgwick and Bell at Siddhapur in October 1919. These three specimens constitute a new record for the Presidency.

ADDITIONAL NOTES ON THE BOTANY OF NORTH BURMA.

BY

F. KINGDON WARD, B.A., F.L.S., etc.

(*With a map.*)

Recently I received from Mr. E. J. H. Corner, Assistant Director of the Singapore Botanic Garden, the Burma diaries which I left there in 1941. Mr. Corner was a prisoner of war throughout the Japanese occupation, but had persuaded the Japanese of the importance of keeping up the Gardens; with the result that not only was he himself in some measure retained to help Professor Tanakadate—appointed by Tokyo University to the Directorship—but he succeeded in saving the herbarium and library both at the Gardens and the Raffles Museum, for which men of science all over the world will ever be grateful. Professor Tanakadate, convinced by Mr. Corner that my diaries were harmless and of some scientific value, agreed to their preservation in the library where Mr. Corner hid them; thus to him also, as well as to the foresight, courage and ingenuity of Mr. Corner, I am indebted for the preservation of what, for me, was irreplaceable. Soon after his release, and before leaving India for England, Mr. Corner posted the diaries to me. As a result I am now able to add considerably to my Sketch of the Botany of North Burma (*J.B.N.H.S.*, Vols. 44, 45) which was written largely from memory and rough notes after I left Singapore in 1941.

Mr. Corner is, I believe, still in England but hopes to return to Singapore shortly. His many friends will wish him luck and many years of health and happiness to carry on the work which he so gallantly stuck to.

TROPICAL EVERGREEN RAIN FOREST (500-2,000 ft.).

The Myitkyina plain, where not cultivated, has been cleared of jungle and in many parts has suffered from over-grazing to such an extent that the dwarf *Phoenix humilis* is almost the only plant which will grow on the hungry ground. Elsewhere are thickets with a great variety of shrubs—forerunners perhaps of the regenerating forest—herbaceous plants like *Amorphophallus Cruddasiana* and climbers both woody and herbaceous; *Porana*, *Argyreia*, and other *Convolvulaceae*, *Thunbergia*, *Mussaenda*, and many others. *Tectona grandis* also grows round Myitkyina, but not it seems further north. Many trees are planted, including a fair number of local species such as *Mesua ferrea*, *Aesculus assamica*, species of *Cassia*, etc. Ascending from the Myitkyina plain to the alpine region, two of the major changes of vegetation are accompanied by an abrupt change in the number of species. The first change occurs at about 9,000-10,000 ft. with the passage from Temperate Forest to *Abies* Forest, accompanied by a distinct drop in the number of species; the second at about 11,000-12,000 ft. with the passage from forest to alpine vegetation, accompanied by an *increase* in the number of species.

In the Tropical Evergreen Rain Forest, plank buttress roots, though they are sometimes seen (e.g. *Ficus glomerata*) are not common. Cauliflory, also typical of the Malaysian jungle and common amongst the Figs of North Burma, is not otherwise conspicuous (e.g. *Mayodendron igneum*).

A species of *Dipterocarpus* taller than the average tree, which is common in the valley of the Eastern Irrawaddy (Nmai Hka), is probably *D. turbinatus;* while all the way up the Mali valley occurs what seems to be *D. alatus.* Nor is there anything strange in the two valleys having different species. There are factors influencing the flora of the eastern valley which do not operate in the western. (1) The proximity of high mountains coupled with the fact that the Sino-Burma frontier ranges were glaciated down to 26 N. lat. and further East to 25°. (2) The proximity of the Eastern Asiatic flora.

Other trees noted in this zone are: *Altingia excelsa*, *Aesculus assamica*, *Hibiscus macrophyllus*, *Betula cylindrostachya*, *Cedrela Toona*, *Sterculia villosa*, *S. colorata*, *S. acerifolium* the three last-mentioned all flowering in the hot weather, *Ficus obtusiloba*, species of *Engelhardtia*, *Acer*, *Lagerstroemia*, *Ulmus*, *Mangifera*, *Nephelium*, *Milletia*, *Garcinia*: several of these become more prominent in the next zone.

Perhaps 10% of the trees in the narrow Nmai valley on the hot sandy banks are leafless for a short time in the hot weather. In April I noticed *Gmelina arborea*, *Bauhinia variegata*, *Stereospermum chelonoides*, *Sterculia villosa*, and *S. colorata*, *Erythrina*, *Albizzia* spp. *Ficus* spp. and *Cassia nodosa* (?) bare.

Above the confluence there is shifting cultivation even so low as 1,500 ft. and big clumps of *Dendrocalamus Hamiltonii* are a feature, perhaps planted, or owing their presence to burning of the jungle. At any rate it is a plant which seems to thrive where the jungle has been cleared. This species had flowered everywhere in North Burma in 1937 or 1938 and, all or nearly all, the plants were dead. Patches of bamboo forest—not the *Dendrocaamus*—also seem to result from repeated burnings; these of course are easy to cut and burn again, but they probably indicate a soil well on the way to exhaustion. A tangle of big climbing plants is also quickly in evidence, notably *Thunbergia grandiflora*, T. *coccinea*, *Mucuna pruriens* *Uncaria pilosa* and *Pueraria*. Tall grasses are good indicators of the same process and suggest an impoverished or badly leached soil; *Imperata* and two other grass species (*Saccharum*?), with the fern *Gleichenia* also suggest a hungry soil. Early comers—this before the clearings go over completely to bamboo or gass—are *Ficus cunia* and other species, *Hibiscus macrophyllus*, *Callicarpa arborea*, *Macaranga* sp. From the outside the forest seems to be completely draped with large sprawling creepers which hang almost to the ground in endless festoons and curtains, but from within nothing is visible except innumerable cords, ribbons, and corkscrews disappearing into the semi-darkness above. Besides those previously mentioned we may note: *Entada scandens*, *Securidaca tavoyana*, *Vitis angustifolia* and *V. lanceolaria*, *Calamus* (a few species) *Dioscorea*, *Smilax Hoya*, *Illigera*, and various *Menispermaceae*. On the tree trunks many root climbers find support as for example *Raphidophora*, *Pothos*, *Freycinetia*, *Piper*, and *Ficus*. Epiphytes include a few orchids like Cymbidium and Dendrobium and the fern Drynaria. The commonest epiphytic fern, probably *Platycerium Wallichii*, Bedome records as 'occurring from the Malay Peninsula southwards'. Owing to a combination of hot weather and drought in winter, tree ferns are rare, being more characteristic of the next zone.

The density of the jungle is largely due to undergrowth. Enough light penetrates between the trees to encourage a thick growth of shrubs and herbs including bamboos. There are also open spaces with tall grasses and shrubs—*Mallotus philippinensis, Maesa, Jasminum, Crotalaria, Rhynchotechum* and others; in damp places are seen *Phlogacanthus curviflorus, Hedychium, Lasia aculeata, Jussiaea,* and various small *Comellinaceae, Cyperaceae,* etc.

A sere sometimes seen on dry rocky slopes where the soil is obviously poor comprises small trees and saplings of various species, including *Litsaea* and *Dracaena*; no undergrowth.

The most interesting sere in this lowest zone however is that in the river bed. In the shrub barrage at the top of the sand bank close to high water mark, besides the shrubs previously mentioned are: *Photinia Benthamiana, Flemingia macrophylla, Phyllanthus* (*Emblica*) *Griffithii, Ligustrum massalongianum, Ficus glomerata* and *F. hispida, Ardisia pedunculata,* species of *Cinnamomum, Boehmeria, Saurauja.* Lower down in the riverbed where there is shingle *Pourthiaea arguta, Homonoia riparia, Salix tetrasperma,* and the Rose previously mentioned are all submerged for a shorter or longer period. Where there is more sand, the fern *Goniopteris prolifera* is common, its runners many feet in length. *Grewia laevigata* is another plant which can withstand submergence, as can *Ficus pyriformis* found on rocks. Most of the strand plants mentioned occur up to 3,000 ft.; some up to 5,000 ft. e.g. in the Ngawchang valley. I have made no attempt to distinguish between tropical evergreen and subtropical hill jungle, so far as these seres are concerned. All the shrubs of the barrage have close growing interlacing stems which help to hold up floating vegetable debris and increase the humus in the soil. They have tremendous root systems to anchor themselves firmly against the current.

SUB-TROPICAL HILL JUNGLE (1,500-5,500 ft.).

As previously pointed out there is a difference between tropical rain forest at 2,000 ft. immediately above the Myitkyina plain, and the similar looking jungle 100 miles further north close to the high ranges, as for example, in the Nmai valley. The same is even more true of the next zone. In the neighbourhood of the snows, plants which occur—if at all—only above 5,000-6,000 ft. in the south, are met with at 4,000 ft. north of Fort Hertz. In other words there is a progressive lowering of the zones as you proceed north to the extent of 1,000-2,000 ft.—with however a difference. At the Seinghku-Adung confluence in lat. 28° Temperate Rain Forest begins at 4,000 ft. and Temperate Pine Forest at 4,500 ft. So also with Sub-Tropical Hill Jungle.

Additional characteristic, though not exclusively, hill jungle trees are: *Acer Campbellii, Lagerstroemia parviflora, Fagraea obovata, Pithecolobium angulatum, Lonicera ovata* (in flower in July), *Castanopsis tribuloides, Ficus Roxburghii, F. bhotanica, F. nervosa,* (which starts as an epiphyte) *Quercus xylocarpa, Q. Thomsoni, Q. fenestrata, Q. lamellosa, Melodorum rubiginosum, Schima Wallichii, Saurauja fasiculata, S. napaulensis, Emblica officinalis,* *Magnolia Griffithii*, *Croton caudatus*, and species of *Sapium*, *Machilus*, *Dysoxylum*.

I have mentioned earlier that many trees common in the Tropical Evergreen Rain Forest ascend into the hill jungle sometimes to 5,000 ft. and that no sharp line of demarcation seperates the two. Why then, it may be asked, attempt to distinguish between them? The answer is that did we not do so we should be for ever trying to analyse the first 6,000 ft. of jungle into simpler parts—and at top levels the hill jungle differs widely from the luxuriant tropical forest of the damp shady valleys; some division there must be to satisfy the urge to simplify which seems to be inherent in us. The one put forward seems reasonable, but it may not be the best possible.

The more or less arbitrary contour of 2,000 ft. as the lower limit of the hill jungle corresponds with an increase in the number of epiphytes, a decrease in the number and variety of strangling figs, an increase in the number and variety of *Lauraceae*, *Euphorbiaceae*, *Urticaceae*, *Acanthaceae*, (especially *Strobilanthes*) *Zingiberaceae* often gregarious, *Araliaceae*, and other families, and of bamboos. Separately these indications of a change in the vegetation do not amount to much; but taken together they add up to something. Besides *Bucklandia*, three other trees,—*Quercus pachyphylla*, *Rhododendron eriogynum*, and *R. stenaulum* mark where the hill jungle passes into Temperate Rain Forest, with a still larger assemblage of epiphytes. Also noticeable in the hill jungle is the emergence of a temperate hebaceous flora, as for example on roadside banks. In the valley of the Nam Tamai at an altitude of less than 4,000 ft. one comes suddenly on species of *Ranunculus*, *Thalictrum*, an *Umbellifer* with finely cut leaves, *Myosotis*, *Valeriana*, *Anemone vitifolia Parochetus communis* and of course species of *Hypericum Campanula* (*C. colorata*) *Lysimachia ramosa*, and *Viola*, nearly all of which are more or less ubiquitous in the tropics but none the less plants of the Temperate zone.

Then at the lower limit of the hill jungle we find such characteristic subtropical climbers as *Entada scandens* and big scramblers like *Acacia pennata* and *A. caesia*, etc. At higher altitudes scandent bamboos are seen.

There is plenty of room for small trees and shrubs, especially towards the upper limit of the zone and lining the river banks. Often the forest is not dense, and here along with many species of bamboo are shrubs and undershrubs e.g. *Rhynchotechum*, *Polygala arillata*, *Osbeckia nepalensis*, *Clerodendron bracteatum*, *C. infortunatum*, small figs, *Eurya*, *Eugenia*, and others. There is also a considerable herbaceous undergrowth of *Marantaceae*, (Stachyphrynum) Musa, *Tacca laevis*, gregarious *Strobilanthes*, *Curculigo*, etc. Epiphytes include *Aeschynanthus grandiflora*, *Ficus nervosa* (which soon becomes an independent tree) Loranthus spp.

On roadside banks is found an unstable sere, the vegetation being constantly slashed and burnt. There is a good deal of moss in which many seedling trees come up; common plants are *Lysionotus*, *Solanum*, *Corydalis*, *Torenia*, *Colocasia* (a gregarious species), *Polygonum capitatum*, *Pratia begoniifolia*, *Plectranthus Coetsa*, several *Selaginellas*. Between Fort Hertz and the Nam Tamai *Plectranthus macranthus* is common along the edge of the forest. A charming white flowered orchid, *Diplomeris pulchella* grows on rocks by the river.

But as previously remarked the most interesting sere is that found in the river bed. In the rocky bed of the Tamai between Pangnamdim and the Seinghku confluence at 3,000-4,000 ft. *Rhododendron Simsii* is still found occasionally. On rocks also are *Ficus pyriformis*, *Astilbe rivularis*; at high water mark in the sand *Neillia thyrsiflora*, and *Glochidion*, with *Equisetum*, ferns, grasses, *Thalictrum*, and *Viola*, but no rose. *Neillia thyrsiflora* really belongs to the next higher zone. Other commonly seen plants in the Tamai valley are *Costus speciosus* and *Leucospectrum canum*.

It is not possible in a short article to give more than a faint indication of this extensive flora; I have wherever possible called attention to such plants as I collected or could name; another botanist might produce a different list of names. But I have also tried to illustrate—and justify, the several climax formations I can recognise in North Burma.

SUB-TROPICAL PINE FOREST.

All the way up the Ngawchang valley between 5,000 and 6,000 ft. with Sub-Tropical Pine forest on one side and Temperate Pine Forest on the other (if sufficiently sheltered) the river banks are clothed with a great variety of trees, shrubs, and climbers both woody and herbaceous, amongst which occur the following: trees:—*Michelia lanuginosa* (replaced in the Adung valley by *M. Doltsopa*, with *Pinus excelsa*), *Ficus obscura*, *Juglans regia*, *Quercus glauca*, *Castanopsis indica*, *Manglietia insignis*, Adinandra (*A. Griffithii* ?) *Engelhardtia spicata*, and *Taxus* sp. the only other conifer. Shrubs:—*Viburnum stellulatum*, *Hypericum Hookerianum*, *Ilex corallina* and other species, *Oxyspora paniculata*, *Ficus lepidosa* and others, a second species of *Adinandra*, several species of *Rubus* (*R. lineatus R. rosaefolius R. ellipticus*), *Spiraea canescens*, and species of *Rhus*, *Ardisia*, *Leptodermis*, *Eurya*, *Derris*, *Gaultheria*, *Hydrangea*, several *Rhododendron*, etc. Amongst climbers may be mentioned *Leptocodon gracile*, *Stemona Wardii* (endemic), *Clematis Buchananiana* and *C. nepalensis*, *Heptapleurum venulosum*.

Other interesting plants are *Boenninghausenia albiflora* on turfy limestone ridges, *Primula densa* (endemic) also on limestone but in deep shade, *Prunus communis* on open hillsides, but seen only near villages so probably cultivated, *Cynoglossum amabile*, and on the bracken clad hills *Artemisia*, *Dipsacus*, *Swertia*. It may be noted that in the Adung Valley, with *Pinus excelsa* instead of *P. insularis*, *Primula dumicola* replaces *P. densa* just as *Michelia Doltsopa* replaces *M. lanuginosa*. The plant associations of the Ngawchang valley close to the Chinese frontier and isolated from the sub-tropical Nmai Hka by the high Pyepat ridge, are more Chinese; those of the Adung valley, more Himalayan and Tibetan. Although 6,500 ft. has been taken as a convenient upper limit of Pine forest, both at Hpimaw and at the Panwa Pass a few miles further south, Pines grow nearly a thousand feet higher, associated with *Rhododendron Delavayi* (a species very similar to *R. arboreum*), Salix, *Quercus Griffithii*, *Rosa sericea.* At the top level there is not much about the vegetation deserving the description sub-tropical, unless luxuriance and variety are to be regarded as characteristic sub-tropical features; they are not exclusively so. Variety of vegetative form there certainly is too—trees, shrubs, epiphytes, climbing plants, herbs; but most of the species have Temperate affinities, and the Sub-Tropical Pine Forest has already passed into mixed Temperate Forest (7000-9000 ft.) Below the Panwa Pass, where the ground is boggy we find *Primula helodoxa*, *Iris*, *Parnassia*, *Caltha palustris*, Aconitum, Gentiana, etc.

However *Pinus insularis* begins lower down than *P. excelsa*, where the vegetation deserves to be called sub-tropical, and does not ascend quite so high. It is therefore convenient to retain the name Sub-Tropical Pine forest for the present at any rate.

TEMPERATE RAIN FOREST.

Taking the entire zone from 5,000 to 8,000 ft. the Temperate Rain Forest is probably richer in species than any other zone of equal depth in North Burma. Many trees regarded as properly belonging to the sub-tropical hill jungle and pine forest actually extend far into the temperate zone; and as already pointed out it is impossible to draw any hard and fast line.

An abundant climber of the warmer levels around 5,000 ft. is *Streptolirion volubile.* Species of *Clematis*, of which there are several, include *C. Henryi* and *C. fasiculiflora.* Epiphytes include *Hymenodictyon parasiticus*, Medinilla, Loranthus.

Shrubs include *Caryopteris grata* and *Leycesteria glaucophylla.* Figs are in general much reduced in size, as well as in variety—*Ficus foveolata*, *F. nemoralis*, and the creeping *F. repens* occur.

In forested gullies where bamboo undergrowth (*Phyllostachys* and *Arundinaria*) is prevalent large colonies of *Urticaceae* are often conspicuous—generally some species of *Elatostema.*

In the cool temperate forest there is an increase in the number of Acers, and probably also of oaks and Ilex, as of *Rhododendron. Acer Hookeri*, *A. Campbellii*, *A. sikkimense*, (generally epiphytic) *Quercus lanuginosa* and *Q. Ilex* are a few. In the temperate pine forest we first meet with the *Shortia*-like *Berneuxia tibetica* (ascends to 9,000 ft.) of the climbing *Trychosanthes palmata* and of a large handsome yellow flowered *Clematis* with simple leaves, found in the Adung valley. The Iris previously referred to as *I. Milesii* is *I. Wattii.*

MIXED TEMPERATE FOREST.

Juniperus Coxii occurs locally. It is a big tree—endemic. Taxus, though scattered, is not rare; it extends to 10,000 ft. Another small tree found in this zone is *Magnolia nitida;* it is apparently confined to the eastern ranges—I have never seen it in the Adung valley.

Between the Nam Tamai and the Tazu river the mountains are covered with Temperate Pine forest below and with Abies forest above; with nothing between. Along the 9,000-foot ridges a variety of shrubs—*Rhododendron Martinianum*, *R. triflorum*, *R. tephropeplum*, *R. megacalyx Enkianthus pauciflorus*, *Skimmia Laureola*, *Daphniphyllum*, *Cassiope*, *Vaccinium glauco-album*, *Clethra*, mark the beginning of silver fir forest. On rocks grow small *Liliaceae* (*Tofieldia*, *Smilacina*) *Coelogyne*, *Carex*, *Ophiopogon*, *Luzula*, and other plants; and under the bushes here I found *Cornus suecica* (now *Chamaepericlymenum suecicum*). A rough leafed *Begonia* with masses of small pink flowers is the only species of this genus to ascend above 7,000 ft. *Rhododendron crinigerum* and *R. oreotrephes*, mixed with *R. arizelum* clothe some slopes where mixed Conifers meet Silver Fir.

Chamaepericlymenum suecicum is not, as previously stated, the only Arctic species in Sino-Himalya (of which alpine Burma forms a part); there are several others e.g. *Androsace Chamaejasme*. As far as broad leafed trees are concerned the Mixed Temperate forest consists very largely of Rhododendrons (about 20 species including epiphytes), oaks, *Ilex* spp. Acers, together with Birch, *Schima*, several *Magnoliaceae* and *Lauraceae* (the former very prominent), and a few *Araliaceae*. Both the species and the proportion of deciduous to evergreen differs widely on exposed ridges and on sheltered slopes. In fact at this altitude the exposed and sheltered flanks of a spur support entirely different formations; while the crest of the ridge is generally clothed with sub-alpine scrub differing only in composition from that found normally 2,000 ft. higher. Which shows how impossible it is to fit nature into a straight-jacket. Such scrub, growing along the windy spurs above the Nam Tamai, for example, and on the way to the Hpimaw Pass, is composed largely of small Rhododendrons mixed with *Arundinaria* and a variety of shrubs and stunted trees such as *Corylus ferox*, species of *Sorbus*, *Salix*, *Populus*, *Deutzia*, *Daphne*, *Cotoneaster*, *Berberis*, *Juniperus*, *Euonymus*, *Coriaria*, *Maesa*, *Eurya*, *Viburnum*, and others. But from 8,000 ft. upwards Rhododendrons are dominant along the rocky spurs. The Mixed Temperate Forest zone is as far as outposts of the true alpine flora have penetrated downwards—it marks, that is to say, the limit of their descent. These scouts, which are none too happy it would seem as they survey their chances of survival in a clash with the Forest, colonise bare rocky outcrops, slips, gullies, screes clearings, whether natural or artificial—in fact any place where vacant possession can be temporarily obtained. A change of climate might of course confirm their hold,—or on the other hand, drive them out. In the Silver Fir Forest these intruders—and opportunities for their expansion—become more numerous.

In the Adung valley, *Primula sino-Listeri* is occasionally met with, on bare ground. Amongst Chinese Rhododendrons which, like *R. Delavayi*, cross into Burma along the frontier near the Panwa Pass are *R. sulfureum* and *R. yunnanense*.

As for Moss Forest, one finds that many of the epiphytic shrubs have drip-tip leaves, and at the opposite extreme are provided with water-storing tissue in the shape of swollen stems (e.g. *Agapetes*, *Vaccinium*)! Other epiphytes are filmy ferns growing in the moss, *Leucothoe*, *Polygonatum*. The habit is usually trailing, with long pendent branches.

Silver Fir Forest.

Epiphytic Rhododendrons include *R. bullatum* and *R. micromeres*, the former one of the most beautiful of all Rhododendrons, the latter one of the very few with repulsive small flowers of a muddy yellow. It however makes up for this lapse by the vermillion and gamboge colours of its leaves in winter. Trees include *R. fulvoides* and *R. gymnogynum*, the former with *R. Beesianum* towards the upper limit of the fir forest. The rather scrubby *Acer erosum* (not *A. candatum*) is found as high as 11,000 ft.: perhaps the last deciduous tree, other than Larch, unless some species of *Sorbus* ascend higher.

Another Chinese plant found in the upper Adung valley is *Primula lichiangensis* is found at 10,000 ft. *Nomocharis saluenensis* is scattered along grassy ridges in this zone, and *N. pardanthina* is associated with *Iris decora* on alluvial fans, but is less confined within limits than most species of the genus, being found between 8,000 and 12,000 ft. With these two grows *Aster fuscescens*. On a similar gravel chute I found a few plants in fruit only of what may have been *Cathcartia villosa* though at the time I took it for an unknown species of *Meconopsis*. It was growing in high meadow at over 10,000 ft. altitude above the Nam Tamai (1937). On rocks in the same gulley a charming dwarf Allium was in flower in September; and under the bushes was a single large clump of an unknown *Hypericum*. None of these plants have been raised from the seed I collected, and future explorers should look out for them. I came to the conclusion that there must be many unknown alpine and sub-alpine plants in North Burma waiting to be discovered.

Other plants of this zone are *Clintonia alpina* found under bushes, and yellow flowered *Helianthemum* on bare stony slips.

The plant referred to as *Iris Delavayi* in Part III is more likely *I. chrysographes*.

Sub-Alpine Scrub.

In this zone woody plants tend to occur in large colonies. Not only Rhododendrons and Birch grow gregariously, but also *Salix* (several species). More scattered shrubs include species of Lonicera. *Streptopus simplex* is common up to 12,000 ft. throughout the sub-alpine scrub. It has attractive lily-of-the-valley flowers, and an engaging fan-like habit.

Other alpine herbaceous plants are *Meconopsis impedita* (a red flowered form grows on rocks in the Seinghku valley); *M. integrifolia*, found only in the Seinghku valley where it is not common;

Primula serratifolia, often amongst *Arundinaria* but ascending to 14,000 ft.; and, in meadow, species of Arisaema, Codonopsis, *Adenophora*, *Delphinium*, and a variety of *Compositae*, *Umbelliferae*, etc. *Primula capitata* on screes, is a late flowering species.

ALPINE TURF AND SCREE.

Two species characteristic of this zone not prēviously mentioned are *Primula muscoides*, and *P. triloba*, both tufted mat plants. In boggy ground *Primula Dickiena* (Gamlang valley); *Gentiana grata*, and *G. stylophora*, both high alpines, Oreosolen, and *Picrorhiza*, the two last named genera peculiar to Sino-Himalaya also occur. *Lychnis nutans* grows on screes, and on turf slopes solid clumps of a fern, *Athyrium felix-foemina* are abundant, with clumps of *Iris Rumaonensis*.

MISCELLANEOUS NOTES

1.—A TIGER CLIMBING A TREE.

I am enclosing two photographs showing a tree, up which a young tiger climbed and which incident is most interesting and probably unique in the history of such animals. The tree is a soft-skinned one, commonly met with in the forests of the Khasi and Jaintiah Hills of Assam. The total height of the tree is about 80 feet and the first branch springs from the stem at about 45 feet. The girth at the bottom is about 9 feet. The cub was lying flat on one of the branches about 15 feet higher than the first branch, and was fired at with a shot gun by a local Garo who wounded the animal in the first shot and then whilst the animal was coming down backwards, he fired a ball cartridge at it but apparently missed. The tiger jumped off the tree and made away into the jungle, with a blood trail going for quite a long distance. My brother, who is a forest officer, and I verified the statement by examining the tree and the trail of blood. From the size of the pug marks and the claw marks up the tree, it was quite obvious that they were those of a tiger cub; probably driven up the tree by wild dogs or its parent as the parents were seen by us in the vicinity the week before.

As I am eager to know if such a case has ever been referred to you before, will you please drop me a line, as this incident would be one of general interest to shikaris bent on big game hunting, and should be brought to more prominence amongst them. It might incidently be the saving of some of their skins when out sitting up on machans.

'PEACHLANDS',
SHILLONG, ASSAM.
13*th March* 1946.

CH. DE LA LONGEREDE,
Hon. Capt., R.I.E., Indian Army.

[There are several instances recorded of tigers climbing trees. In vol. xxxiii, pp. 196-197 of the *Journal* the editors reviewed the literature available on the subject. The maximum height so far recorded is 30 feet; the present instance doubles the known record. The photographs were unfortunately unsuitable for reproduction.—EDS.]

2.—A TIGER 'RUNS AMOK'.

An article in the Calcutta *Statesman* of below date reads: 'Man-eater kills 7 coolies, is then killed in battle with wild buffalo.' It then proceeds to give details which appear to me to be inconsistent.

A man-eater is reported to be usually a *sneak thief* and kills for food alone due to some incapacity, old age, and sometimes from inheritance. No wholesale slaughter such as described above is committed at one time, and that in the presence of an audience presumably in daylight in or near a village and railway station.

Further and fuller and correct details would be very instructive to individuals interested in the study of the psychology of the Carnivora.

From the report as it appears, the tiger is incorrectly described as a *man-eater,* and there is reason to conclude that there is some other phenomenon which has caused this tiger or tigress to 'run amok'.

Your opinion and those of the members would be a valuable contribution.

CORONATION COURT,
4 WEST RANGE, PARK CIRCUS, CALCUTTA.
9th February 1946. S. A. CHRISTOPHER.

3.—A PANTHER WITH TWENTY CLAWS.

On closely examining a panther that I had recently shot I discovered something unique about the claws. On the hind feet it had two extra claws corresponding to the Dew claws in front. Not a malformation, for these claws were fully developed and retractile. I had never met with such an unusual case, nor have my friends, and it must be very rare in feline animals.

It is probably the experience of all big game sportsmen that no two animals are identical, but it would be most interesting to know whether such cases of twenty claws instead of the usual eighteen, are rare enough to be freaks.

I wouldn't say that my panther beats are always productive of interest to naturalists, but even if I shoot another hundred animals, I think I shall find no less interest in my sport than on previous and less exceptional occasions.

LUNAWADA, VIRBHADRASINH,
14th February 1946. *H.H. Maharana of Lunawada.*

[There are at least three records in the *Journal* of panthers having twenty toes. In vol. xxx, p. 909 a photograph appeared illustrating such an abnormality.—EDS.]

4.—TIGER KILLS LIONESS.

A tragedy took place recently in the Chamrajendra Zoological Gardens in Mysore City, South India.

Tigers and lions are kept in a large cage in the Zoo, each species in separate compartments. There is an open enclosure with a deep trench all round, and tigers and lions are let out into this enclosure alternately.

Recently a large tiger was let out into the enclosure. The keeper, when cleaning the cage in which the lioness was, admitted her into her adjoining cage without noticing that the door giving access to the enclosure was open. So the lioness went into the open enclosure into which the tiger had already been admitted.

The tiger at once attacked the lioness. A terrific battle ensued and the lioness put up a brave fight for her life. But she was no match for the tiger and everything the keepers and others could do was futile, so the poor brave lioness was soon killed.

Even a full-grown lion has been known to be no match for a full-grown tiger, the lioness therefore had even less chance, and the poor creature lost her life through the carelessness of a keeper.

MYSORE,
23rd January 1946. CHARLES THEOBALD, F.Z.S.

5.—A QUEER ANIMAL HABIT.

I should be glad to be enlightened as to the purpose, and its reason or cause, to which had been put some small, smooth, cone-shaped rocks which I found in two and far apart caves, while shooting in the N. Chanda Div. before this war, and referred to in my diary as 'wiping stones' (for lack of a better term to suggest the use to which they seemed to have been put by animals, but of whose identity I am still in doubt). Perhaps if I narrate the circumstances in which I found the stones, while describing them, someone might be able to suggest answers to the obvious questions—while an authoritative explanation will be all the more welcomed.

The first cave was shallow and wide open—formed mainly by a projection of the floor to form a narrow ledge outside and which was not completely overhung by the roof, so that the interior was exposed to much of the southern sky; it was situated on the southern face of a rocky spur projecting westward from a low tableland. I had been informed that this cave usually harboured a bear during the hotter part of the day (summer). I never found this cave occupied, nor any visible tracks on the floor, for the surface of the rock that formed it was covered with a thin layer of fine grit. It was during my first visit, while awaiting the return of the occupier (if any) that I noticed a conoid outcrop of rock close to the entrance at one side—because its upper surface was black. I found that it was thinly and fairly evenly smeared—almost glazed—with a black, tarry, substance (but quite dry) which, when I smelt it closely, stank like the faeces of the larger carnivora. Just beside it was a low, smooth, and slightly convex outcrop of rock which bore smudges and smears of the same foul-smelling tarry substance. When questioned, my Gond companion merely muttered 'Reech' (Bear). As our 'lingua franca' was a smattering of Marathi on both sides, I left it at that—though pondering the fact that the excreta of many bears I'd examined in that block consisted mostly of residues of fruits and black ants, also that I had seen the fairly fresh faeces of a panther on the crest above us, while stalking the cave that forenoon. About a fortnight later, while examining the ground near the toe of the spur for signs of the bullet that had smashed the shoulder of a tigress there (which, though badly crippled, had cleared out of that locality), I got a perfect 'sitter' of a shot at a panther couched on a rock almost directly above the cave (and, as so often with easy 'sitters'—though here tempted by the offer of a thick neck against the sky—missed). A troop of lungoors was always in the jungle below and some usually sat on the toe of the spur before the sun reached it. Of the numerous bears and many solitary boars that roamed the block I saw, here, only one bear, three boars, one porcupine, one civet cat—and, animals unlikely to use caves, sambar, chital and only 2 four-horned antelopes. A pack of jackals found the uneaten carcase of a buffalo on the third night after the tigress had killed it. And the only hyaena I saw was more than a mile from that spot.

The other cave, much larger and deeper, was more than a straight mile away to the south-east, where a nullah cut down through a part of the tableland and found its way out southwardly through sheer cliffs. It was while first reconnoitring the block that I found blurred tracks of a tiger in the gravel of the upper part of the nullah. Losing these tracks where the dry bed was bare rock, the Gond told me that, further down, was a cave which a bear (or bears) occupied during the hot hours of the day (this the month of May and the 'Loo' blowing down the nullah like gusts out of an open furnace). The cave was where the high cliffs began; wide and low of entrance it ran about 40 or 50 feet into the base of a cliff, and two tunnel-like bolt-holes connected with the main passage, from one side. After making strange noises here and then at the mouth of the cave, we gratefully rested just within the entrance and without exploring the dim interior. Almost directly opposite, but high in the other cliff, was another small, oval, cave; the abode of the jungle 'Deo' (god)—for long the legendary protector of the two tigers I knew to be in the block then—and hewn steps led up to it and vermillion paint daubed its arched entrance. Just within the lower cave, and to one side, was another—but more conical—outcrop of rock, having a remarkable resemblance to a phallic stone, smeared with the same stinking, tarry, substance. The light was sufficient to reveal that the floor surface at the entrance had been lightly 'disturbed'—no more than just that; but I could not find footprints nor hairs, nor could I detect odour of animal or human occupation (poachers were usually busy after moonrise and I found two of their 'hides' in the jungle; apparantly, caves do not appeal to them, though I often contemplated sitting up in one of these two and refrained only because I was out for tiger and the chance of success was too remote). To my enquiry about the use of that conical stone, my companion again ascribed it to bears—now making a gesture to, and significant movements with, his buttocks. So I wrote in my diary that night, 'Found another wiping-stone there'.

I'd like to mention now that there were a few small, but deep, cliff-caves further down that nullah and which certainly did harbour bears—by which same token I was without sufficient curiosity to enter them. The wounded tigress was finally discovered lying just within the entrance of the large cave and was killed there; she had caught and eaten a porcupine at the first pool (stagnant) lower down the nullah, the night before. My Gond friend, naturally, attributed the satisfactory conclusion of this anxious episode to the fact that he had previously propitiated the 'deo' in the cave high up in the opposite cliff; but he seemed to maintain that the large cave was used only by bears and clearly did insist that the tigress had *had* to come there to die because she was the protege, the 'protected', of the 'deo' in the opposite cave! To me an unsatisfactory explanation of the conical stone; for, while measuring and photographing the tigress, I reverted to the subject of that stone. And, from a passing acquaintance with many more caves of that size in India, I had formed an opinion that the larger, more 'open', caves were favoured by tiger and panther, though rather as a 'pied a terre' and on a tacit understanding of 'first come, first served'—bears included; and any small tunnels or burrows within, used regularly by smaller creatures, e.g. porcupines. Indeed, in the southern spurs of the Satpuras I was once shown an almost similar cave and told that, every year, a tigress came there to whelp (probably not the same one annually) and that one was using it then; and, as a matter of interest, I did flush a heavy, sleeping tigress that morning and within a hundred yards of the cave and, as she went lobbing and crashing across my front, I did think she was in cub. But actually, she had been sleeping, heavily gorged, between two of her natural kills.

The stones mentioned still remain a puzzle to me. If used to relieve an irritation caused by worms, surely the attempt would have been made soon after defaecation (as in the case of dogs); and, except for only the droppings of bats in the larger cave, there was none of any kind in either. And while conceding that a bear —because of its all-over shagginess—might be accustomed to thus remove any soiling that had occurred during defaecation, I cannot imagine the larger carnivora having need to do the same, nor that their siesta would be disturbed by such a desire. Yet, that tarry substance stank of the faeces of tiger and panther, with the black of a blood meal—and I cannot understand *how* those protrubing (about six and eight inches high, respectively) stones were so evenly smeared over all their upper surface and down to within a few inches of their broad bases (roughly about 8″ × 12″)!

SINGAPORE, K. BOSWELL,
10*th April* 1946. *Capt., I.A.M.C.*

[Mr. R. C. Morris to whom Capt. Boswell's interesting note was sent for opinion, comments as follows:—

'*Bears do,* I think, rub themselves on rocks on defecating after feeding on the pods of *Cassia Fistula* ('Indian Laburnum').

I have observed this on certain rocks in dry river beds: and the local Sholagas gave this explanation.

I have also frequently observed that stones in caves commonly used by bears have a polished appearance; though I have never smelt them. The pods of the *Cassia Fistula* contain, as you know, a thick black tarry substance, which envelopes the seeds, and the Sholagas say that this causes fouling of the hind parts of the bear on defecation; and the animal then resorts to rubbing on rocks.'

This may be the answer to Capt. Boswell's query.—EDS.]

6.—'DRAG MARKS' MADE BY THE KYANG (*EQUUS HEMIONUS*).

The Kyang or Tibetan Wild Ass is common and abundant in the neighbourhood of the lakes Mānasarōwar and Rākhas Tāl in Western Tibet. On a recent visit (June-July 1945) I met with it everywhere on the Barkha Plain (*ca* 15,000 ft. elevation) in troops of 5 or 6, and large herds of over 100 animals. On the bare steppe they frequented I was constantly coming upon curious drag-marks—irregular wavy or meandering lines 2 to 2½ in. wide and 10, 20 or up to 30 yards long, looking exactly like those left by a frisky cow that has a pole or faggot tied to its neck with the loose end trailing on the ground between its forelegs.

There seems no doubt that these marks were produced by the Kyang; exactly how or why is the mystery. The Tibetan yakman explained that they were made by a stallion dragging one of his hoofs along, but could give no reason or say under what circumstances it was done, so all I remarked in my diary at the time was 'Why is the ass *such* an ass?'

It would be interesting to know if something has been observed in the habits of the Kyang to suggest the real or probable explanation.

33 Pali Hill, Bandra,
Bombay, 20.

SÁLIM ALI.

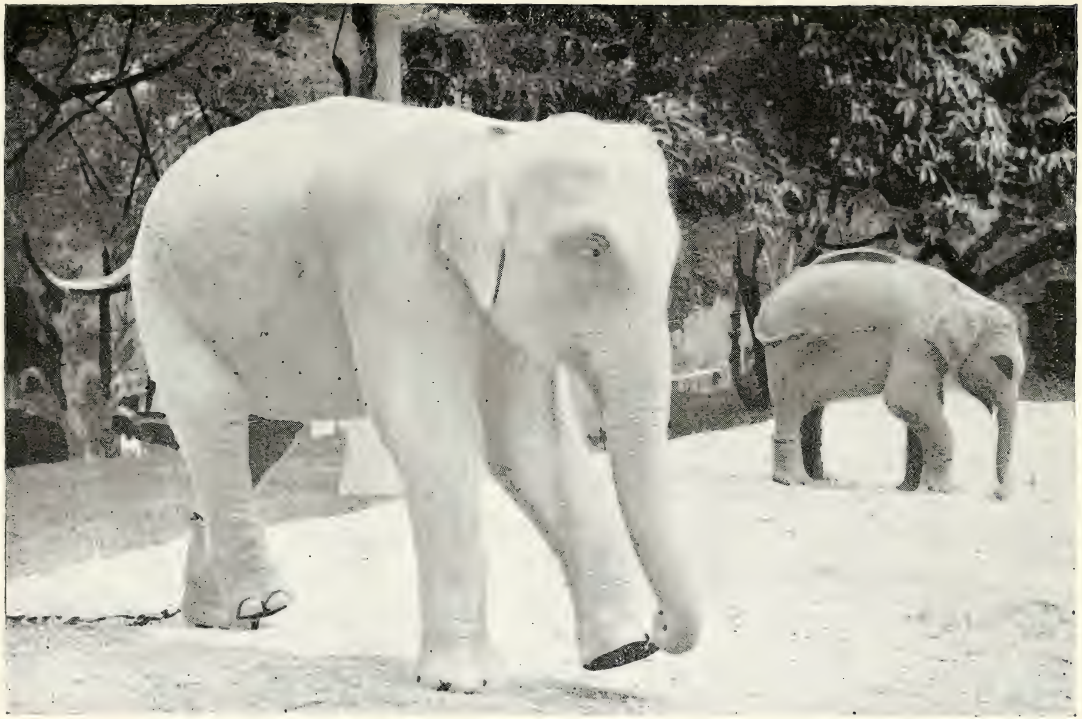
7.—AN ALBINO ELEPHANT FROM THE TRAVANCORE FORESTS.

(*With a plate*)

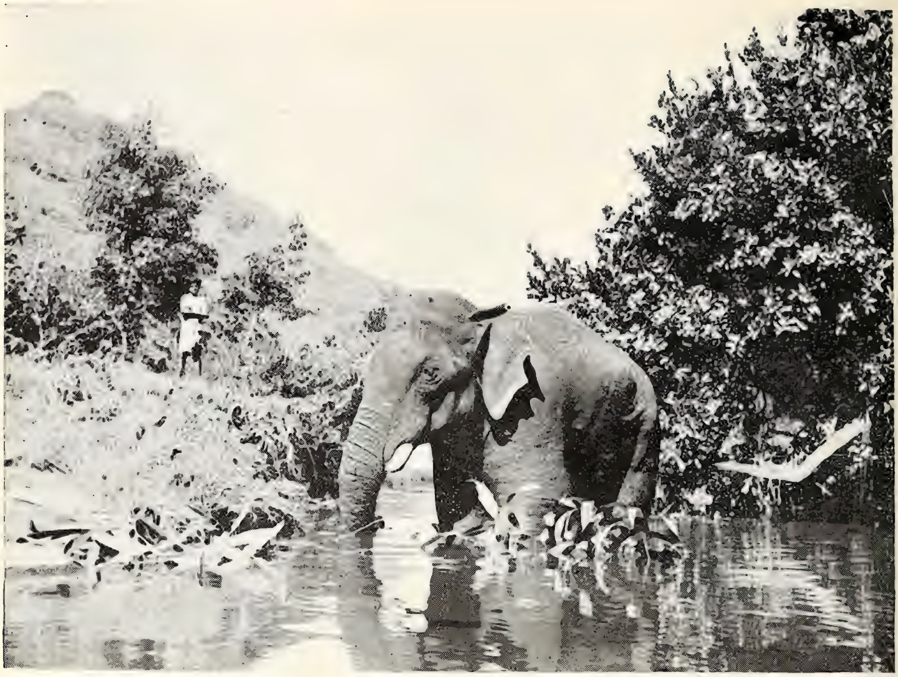
A cow elephant, captured from the Travancore forests in April 1945, has aroused much interest on account of its colour and other attributes of a white elephant; and it may quite possibly be the first time that an elephant having the characteristics of either partial or complete albinism is observed in India.

This elephant, having a height of 5 ft. 11 in. at the shoulder and whose age is estimated to be 10 years, was caught in a pit at Karippanthode, about 13 miles from Koni, the headquarters of the Central Forest Division. Rao Bahadur T. V. Venkiteswara Iyer, Conservator of Forests, Travancore, examined the animal and finding that it compared favourably with the Siamese White Elephants she has been brought over to the Trivandrum Zoological Gardens for exhibition.

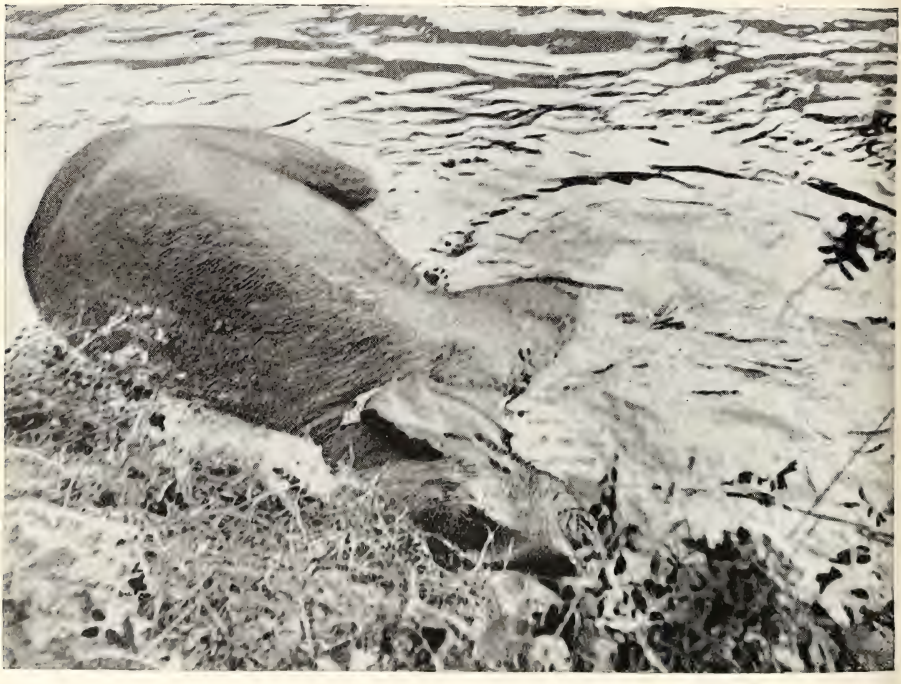
Maheswari, by which name she has since been known, has a light pink skin with white hairs except at the tip of the tail, and pearl eyes. The white hairs on the head are prominent and in spite of them, the light pink background of the skin, gives the elephant a pinkish gray colour. The usual black colour of elephants is nowhere visible on its body. The mouth and palate are also light pink. There are, as usual in ordinary elephants, eighteen toes, four on each forefoot and four on each hind limb, but the toe-nails are



An Albino Indian Elephant from Travancore.



A DYING ELEPHANT. Note the swollen foreleg.



The same animal the next day—DEAD.

of a lighter colour, rather whitish. In all other respects, there is nothing to distinguish it from a normal elephant. She has been under observation for about a year now, and it may be remarked that no change in its colour has taken place during this period.

In a note 'on White Elephants' in the *Journal* (vol. xxvi, 1918, p. 285) Mr. H. Macnaughten refers to a white elephant calf in Burma, which though possessing a light coloured skin at birth had grown perceptibly darker as it grew up. Mr. D. F. Macfie also records (*Journal, Bomb. Nat. Hist. Soc.*, vol. xxxii, 1927, p. 214) the birth of a white elephant calf in N. Siam, and mentions the chief points looked for in white elephants to be light red skin, white hairs on body and tail, very light pink palate, eyes of a light bluish pinky colour and white toe-nails. Evidently, a milk-white colour is not to be expected; the 'whiteness' of an elephant is therefore determined on the possession of the above 'points'. On the basis of this the Travancore specimen has all the attributes of an albino elephant.

Albinism may be observed in any species or any locality and any inference from its distribution may or may not be true. The singularity of the occurrence—though there is only the present solitary instance—of the albino form of *Elephas maximus* on the Malabar Coast, as it has been classically confined to S.E. Asia, may perhaps be significant in affording another instance of faunal affinity between these two regions, a kinship similar to that existing among the Pig-tailed and Lion-tailed macaques, leaf-monkeys, lorises, and civets.

ZOOLOGICAL GARDENS,
TRIVANDRUM, TRAVANCORE.
20th March 1946.

E. S. SIMON,
Curator.

8.—NATURAL DEATH OF ELEPHANTS.

(*With a plate*)

The accompanying plate illustrates two stages, before and after the tragic, natural end of an elephant. The upper of the two photographs appeared in the *Phoenix Magazine* under the title of a *Dying Elephant*, and was submitted by Major P. B. Leahy. The photograph was taken in the Travancore jungles. Mr. F. Connell drew our attention to this fine picture and we tried to get in touch with the author for further details. Owing to the absence of Major Leahy from India, Mrs. Leahy kindly replied and sent us the following details as well as the photos :

'Firstly, I am afraid I have no copy to spare of the photo, but will enclose the negative, and, perhaps you could have it done in Bombay, exactly as you want it for reproduction in your magazine. The other photo I enclosed shows the elephant dead, but, from my point of view as a photographer, and, not a Big Game Hunter it is a bad photo. However you may be interested.

We had heard the elephants making an awful noise in the jungle a few days before this 'subject' was brought to my notice by some coolies. I gathered there had been a fight between two males, but, it was confirmed when I arrived at the spot where the loser was awaiting death. His leg which was badly swollen made him completely immobile. It can plainly be seen in the photo. If the popular belief about elephants going to the accustomed burial ground be true, there is very good reason why this one couldn't do it as he couldn't walk. However this is not the first elephant to die in the 'Civilisation' of this District. There was another only a few months ago, but, I have no information about that one. It is quite possible that he was also wounded.'

It is a common belief that elephants, and several other animals, anticipate death and accordingly retire to a common 'burial ground', but though certain circumstances suggest this belief, such as the discovery of the remains of several animals in one locality, there is yet no proof forthcoming and must be treated as a popular belief with no foundation. However, it seems possible that a wounded or otherwise weakened animal may retire to a secluded spot in the jungle, or as in the case of elephants, into a river or other marshy ground; they do so not because they anticipate death, but as a means of self-protection. The wounds in the meantime perhaps become sceptic and the animal is impeded, or the ailment may increase beyond recovery and the animal succumbs to its fate. The point of seclusion may possibly be the only one in the neighbourhood and on this account many animals may consequently retire to the same spot and die. This would undoubtedly result in an accumulation of remains which would naturally give rise to the secular belief of a 'communal grave yard'. But that this is not so is supported by the fact that several animals have been recorded as found dead in the forests.

In the Tropics the agencies of destruction under natural conditions are so rapid and complete that even the carcases of large animals soon disappear without leaving any traces. It is on this account that dead animals are rarely met with in the jungles.

EDITORS.

9.—A LARGE WILD BOAR (*SUS CRISTATUS*).

In your letter you were good enough to inform me that the average height of male wild boar at the shoulder is 36" and the largest specimen recorded 38½". But in Mr. Burke's statement I find that a wild boar has been recorded up to 40" in height. I give below the measurements of the record wild boar given by Mr. Burke in his *Field Shikar Book* :—

Length 68".
Height at the shoulder and between pegs 40"
Girth at the collar 43½".
Maximum girth 60".
Tushes 10¼".
Tail 12".

What you mention as the record wild boar is smaller than the record given by Mr. Burke. Probably it is due to the fact that the shooter did not send any information to the Natural History Society.

A monster wild boar shot by me last winter is worth recording. So I send you the following measurements, taken in the presence of several reliable gentlemen:—

Length 67″.
Height between the pegs 39″.
Girth at collar 45″.
Maximum girth 61″.
Tushes 7½″.
Tail 10½″.

PHUL-BAGH PALACE,
MAHISHADAL, MIDNAPORE DIST.,
BENGAL.
29th June 1945.

D. P. GARGA,
Kumar of Mahishadal.

10.—'SHAMMING DEATH'.

In an editorial foot-note to the account of a Sambar's death, by Capt. Crawley, in Vol. 45, No. 3, you take exception to the expression 'Shamming death'. I myself have been subject to the same criticism by Pocock, in his Mammalia, with reference to the Hyaena. Mr. William Hornaday, Sc.D., A.M., for years Director of the Zoological Park, New York, and author of a number of books about animals based on years of experience in the field, has, in his well-known book *The Minds and Manners of Wild Animals*, published a picture of an opossum (p. 166) with the caption 'An Opossum feigning death'.

It is an observed fact, witnessed on hundreds of occasions, that numbers of animals do 'sham' or 'simulate' or 'feign' death.

It seems to me that it is 'up to' our critics to supply us with some other term which will adequately describe what takes place and at the same time avoid offence to the hypercritical, as I can think of none which more aptly portrays what takes place. The assumption that the users of these terms are asserting that animals are death conscious and make use of their knowledge cannot in any way be sustained. The terms used accurately and concisely describe exactly what takes place and do not go beyond this: whether the animal's behaviour is conscious or instinctive is entirely another matter.

It is well known that birds will feign injury, to entice a dangerous animal from the vicinity of their young. Is this reasoned or instinctive action?

What is to prevent an animal going a step further, and simulating death itself? Personally, I do not believe that animals are conscious of death. Time to them is infinite, and a dog lying sick unto death, has no realization that he is about to die. Nevertheless to ascribe the simulation of death to instinct alone is unsatisfying. I think it possible, that an animal killed violently, while in full health, may realise, in his last moments, that his dissolution is imminent. When this happens a number of animals give a peculiar cry, quite different from any cry they have ever made hitherto. They make it only once in their lives: immediately preceding death.

It is significant that feigning death is often associated with imminent death by violence.

I have heard this death cry most frequently uttered by boars: this is no doubt due to the fact, that when pigsticking the circumstances of death are such as to induce the cry. I can recall the death cries of stags and horses. The latter is an excruciating sound which haunts one.

How can one explain this death cry? Are we to be satisfied with instinct as an answer? Excessive fear is ruled out by the boar's behaviour at the time.

The main purpose of this letter is to invite readers of the *Journal* to record and publish any observed facts bearing on this most interesting subject, viz. 'Shamming death'.

ELGIN, SCOTLAND.
6th January 1946. A. A. DUNBAR BRANDER.

11.—DISTRIBUTION OF THE RED-CRESTED POCHARD IN SOUTHERN INDIA.

On 9th February 1946 when shooting at Tyravallur lake, about 30 miles from Madras, we got four Red-Crested Pochard (*Netta rufina*), two drakes and two ducks.

When I returned to camp, I looked this species up in the *Fauna of British India* (Stuart Baker) and found that he says that there are hardly any records from southern India, so I thought I would write to you.

On several occasions lately I have seen the Common Pochard (*Nyroca ferina*) on various lakes round here but have not yet taken any. I believe them to be rare in southern India also.

I have preserved two skins of the Red-Crested Pochard and have done soft part studies of them, which I can send if confirmation is required.

I would be obliged if you could let me know what the status of these duck is in southern India. On Tyravallur there were about 200 Red-Crested Pochard which regularly flighted from one end of the lake to the other over some islands, providing ample opportunity for observation.

82 SQUADRON, R.A.F., S.E.A.A.F.
11th February 1946. H. G. LUMSDEN.

[According to the *Fauna of British India*, the Red-Crested Pochard (*Netta rufina*) becomes rare in southern India. In his recent report on the Survey of Eastern Ghats, Mr. Whistler mentions that Mr. Stoney killed 12 Red-Crested Pochards in the Vizagapatam District in the season of 1928-1929. There are two specimens in the Madras Museum labelled Madras and Arkonam, but that he (Whistler) can find no other record for the Presidency.

The Common Pochard (*Nyroca f. ferina*) is a scarce winter visitor to the Madras Presidency. Mr. Stoney informs us that he shot two in the Vizagapatam District in the same season, 1928-1929.—EDS.]

12.—'BIRDS ON THE HINDUSTAN-TIBET ROAD, N.-W. HIMALAYA'—A CORRECTION.

In the list of birds given in the above-mentioned article, which appeared in Vol. 45, No. 4, of the *Journal* of the Society, I regret that by a careless mistake on my part '*Trochalopteron lineatum lineatum* (*Vigors*): Streaked Laughing-Thrush' was omitted, and remarks relating to that species were erroneously recorded under '*Trochalopteron variegatum variegatum* (Vigors): Eastern Variegated Laughing-Thrush'. The latter was noted only at Thanedar and Bagi, specimens being collected in both of those localities.

RAWALPINDI.
30th April 1946. H. W. WAITE.

13.—THE PARADISE FLYCATCHER AT SEA.

While on a trip from Bombay to Cochin and still 100 miles north of it and 15 miles from land, I noticed two paradise flycatchers, both cock birds in full plumage (white and black), on the ship's rail. They were first noticed at about mid-day and stayed with the ship till it arrived in Cochin.

I have always been under the impression that these birds live mainly in the north but it is possible owing to the proximity of the Nilgiris that they are to be found as far south. They must have flown from the land to the ship and as they are known not to be long-distance birds, this has caused me considerable surprise and I am writing to inquire whether what I saw was unusual or not. I would be grateful for your comments.

PHOENIX BUILDING,
BALLARD ESTATE,
BOMBAY. R. SASSOON.
28th March 1946.

[Finding Paradise Flycatchers under the circumstances described is certainly most exceptional. The birds must obviously have been blown out to sea. But there is, of course, nothing unusual in the species occurring as far south as Cochin. In winter it is found in South Travancore, and even Ceylon. EDS.]

14.—SPRING PASSAGE OF PHALAROPES IN IRAQ.

In 1925 Col. R. Meinertzhagen, reviewing the distribution of Phalaropes, (Ibis, p. 325), wrote of the Red-necked Phalarope (*Phalaropus lobatus*) 'winters in the north Indian Ocean. . . . May records from Transcaspia and Shiraz, Persia . . . but still on the Mekran coast on 15 and 20 May'. On 23rd May 1943 I saw large flocks totalling eight to eleven hundred near the edge of the flooded Hor el Hammar, four miles west of Shaiba, Iraq. On 6th June two to three hundred were seen. C. B. Ticehurst in 'Birds of Mesopotamia' (*Journ., Bomb. Nat. Hist. Soc.*, 1921, Vol. XXVIII, p. 197

et seq.) quotes no records other than Zarudny's statement that the species was a winter visitor.

Of *Phalaropus fulicarius* Col. Meinertzhagen wrote 'winter visitor off Mekran coast and south coast of Arabia . . . its passage from Central Asia to Mekran coast takes place in huge bounds with few records of intermediate rest'. On 23rd May I watched one female in full breeding plumage at a distance of twenty feet among the flocks of *P. lobatus*. C. B. Ticehurst knew of no Iraq record. No specimens were shot, but I am familiar with both species, having photographed them in Iceland.

82 A.T. Coy., R.I.A.S.C.,
Benares Cantt.
12th April 1946.

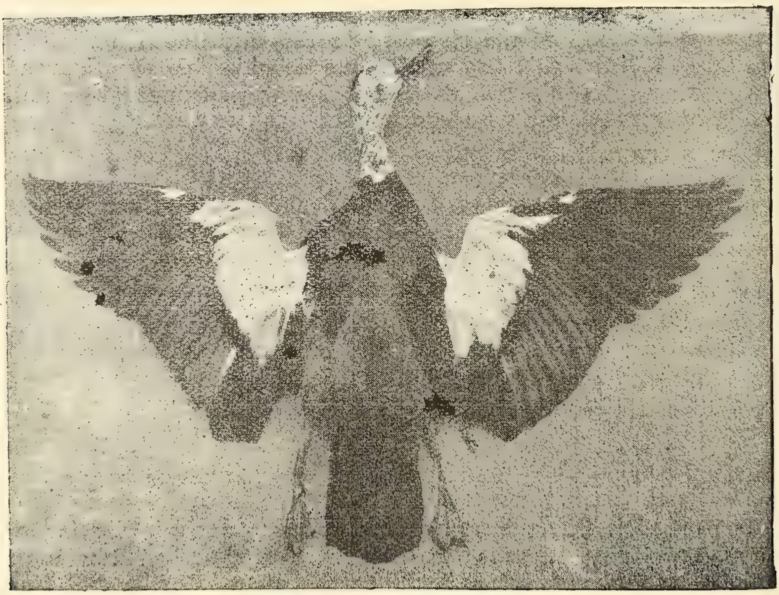
Maj. P. I. R. MACLAREN.

15.—THE WHITE-WINGED WOOD-DUCK

ASACORNIS SCUTULATUS (Müller)

The following notes on the White-winged Wood-Duck are compiled from observations of a pair which were discovered on the Dhunseri river at Manipur Road (Dimapur), Assam.

The presence of these birds was first brought to my notice by Capt. P. T. French in February 1945. From his description of a pair of duck he had seen flying down the river several times, and also swimming and feeding in places, I had no hesitation in assuming them to be Wood-Duck.



White-winged Wood-Duck

I was unable to observe them at that time, but on my return from leave in July, I was able to spend two evenings on the river in the company of Capt. French. He informed me that the duck had not been seen for about 2 months, and only the drake was to be seen, flying down the river every evening. It aparently spent the day some distance upstream, since he had observed it at various points at different times on the river up to 5 miles upstream, from the bridge, and that it was most regular in its habit of reaching the bridge at dusk, about 6.30 p.m.

On the 31st July we took up our position at a point about 100 yards above the bridge. At 6.40 p.m. we heard the drake call as it flew down stream towards us. It came into view about 100 yards away and flew up into a tall tree on the opposite side of the river, about 50 yards distant.

Capt. French stated that its normal practice was to perch in that same tree every evening, watching the bridge until a suitable lull in the traffic, whereupon it would continue its flight. As he had seen it on one occasion at least 1½ miles further downstream still flying, it appeared to fly a fair distance each day.

We walked upstream, and when we were nearly opposite the tree the drake flew out and upstream uttering a loud goose-like 'honk' of alarm finally perching again in another tall tree overhanging the river about 100 yards away.

We took cover behind some bushes and waited for it to resume its flight downstream; but although it commenced calling again it refused to move, so when it was completely dark we abandoned the scene.

The following evening we took up a new position about 200 yards upstream from the tree in which it had perched the previous evening.

I heard it call once some distance away, then it suddenly appeared almost opposite my hide, flying low over the water. It saw me the instant I raised my gun and giving a honk of alarm swerved away, but a charge of No. 5 brought it down into the river from which it was retrieved a few minutes later. The bird was a fine male and apparently in nuptial plumage. Its crop was full of small black pyramidical seeds of an aquatic plant which abounds in the jheels in Assam.

When the two ducks were observed together earlier in the year, they were in the habit of calling to each other using the low whistle which appears to be the ordinary calling note. When alarmed the note is a loud goose-like 'honk'. It is probable that the drake spends the day on some distant jheel or on the river and visits the nesting duck every night; but as the nest has not yet been discovered this cannot be confirmed. The female, when last seen, closely resembled the male, whose description follows.

Weight, 6½ lbs.

The bird proved to be good eating though a trifle coarse. The flavour was not marred by either a fishy or muddy taste. It would have been improved considerably by sage and onion stuffing, though this luxury was unfortunately denied us.

604 Ind. E. & M. Coy., I.E., S.E.A.C. T. C. HUTCHINSON,
1st *August* 1945. *Major, R.E.*

16.—DO SNAKES DRINK MILK?

While reading *Marvels of Reptile Life* by W. S. Berridge, F.Z.S., I have come across the following interesting passage:—

'All snakes drink very freely, and many of them are very fond of milk. In India, the natives will place saucers full of milk near the hiding places of cobras, or in the temples where they are worshipped, in order to propitiate the reptiles; while the Racer or Whip Snake, to quote the words of Lawson "haunts the Dairies of careless Housewives, and never misses to skim the Milk clear of Cream".'

I have experimented with two cobras and a saw-scaled viper and I can assure you that none of these snakes showed the slightest inclination to take this inviting drink. I have spent some years in places where dangerous snakes, including cobras, are quite common, but I know no instance of any snake having even touched a saucer of milk either offered to it or left by a careless housewife. A learned friend of mine has positively declared that the belief that snakes drink milk is quite erroneous and that milk forms no part of their diet. I may add here that this friend of mine has kept many live snakes.

You know well that Indian snake-charmers play upon the belief of laymen that snakes have a strong liking for milk and these garudiwalas induce the public to pay something to feed their reptile pets on milk. I have more than once offered an attractive tip to snake-charmers if they would feed their snakes on milk before my eyes and I assure you that every time either they have failed or refused to demonstrate on some pretext or another.

May I request you to let me know your views on this interesting subject?

80 A, KURLA ROAD,
ANDHERI. V. M. VASU,
20th February 1946. *Advocate.*

[A thirsty snake will readily drink any liquid, be it water or milk, to quench its thirst, but will show no preference for milk. Milk is not a reptilian food.—EDS.]

17.—AESTIVATION OF THE FROG *RAMANELLA MONTANA* (JERDON).

At Khandala, Western Ghat, on the 20th January 1945 while turning out the debris in a hollow of a tree, I turned out what, at first sight, appeared to be two coleopterous larvae which had been ruptured in the process, but on closer examination they proved to be a pair of frogs, *Ramanella montana*. The hollow was about two feet above the ground and its contents were slightly damp. The behaviour of the frogs at the time of disturbance was certainly curious. The short legs were stiffly, and well tucked into the body and handling did not induce the animals to move them; the body skin was thrown into numerous folds; a strong fold of skin across the head forming a high ridge close behind the eyes from under which the strikingly small, beady eyes peered out. In this condition the animals looked in all the world as though they were a pair of ruptured larvae of the Rhinoceros beetle (*Oryctes* sp.). In general colouring they were a pale olive grey above and heavily mottled with deep brown and grey below; a brownish, black bordered band crossed the thigh, the middle of the leg, and a third a little way below the 'heel'. When the legs are drawn up the three bands appear confluent; similar bands crossed the forearm and the 'wrist'; a black, broken W-shaped marking was visible at the base of the skull, anterior to this are two black spots and another nearer the snout. The markings appear to be permanent and are still visible in preservation.

On dissection the two proved to be male and female. Except for size, and some paler patches behind the head and about the loins in the male, there did not appear any marked external differences between the sexes. The female measured 45 mm. from snout to vent, and the male 33 mm. An examination of the gonads indicated that the ovaries were slightly enlarged and the ova distinctly granular. The fat bodies were much enlarged and filled the greater part of the abdominal cavity. The testes of the male were still small, and like the female, the fat bodies were enlarged and occupied a considerable portion of the body cavity.

Be it coincidence or otherwise, this was the first time I found a pair, male and female, of this frog aestivating together. It is well-known that some other species of frogs collect and aestivate together in the same cavity.

Bombay Natural History Society,
Bombay, C. McCANN.
20th March 1946.

18.—THE DISTRIBUTION OF *RANA LEITHII* BOULENGER.

Judging from the fact that *R. leithii* was represented by a single specimen, the type, in the British Museum, Natural History, up to the time it was 'rediscovered' by me at Khandala (vide *Journ., B.N.H.S.*, xxxvi, p. 167) it would appear to be a rare species, but since then I have been able to record it from various other localities in the Bombay Presidency, viz. Gersoppa Falls, N. Kanara; Kanari Caves, Salsette Island; Lingmala Falls, near Mahableshwar; and recently I collected it at Matheran, the type locality.

In most of the above-mentioned localities the frogs were frequent, but at Matheran they were definitely *very common* at dusk after the thunder showers on the 10th and 11th June (1945). There were actually hundreds hopping about the roads, among the rocks of the boundary walls and among the fallen leaves. When I mentioned to my companion Mr. Manek Captain that the frogs appeared to me to be the 'rare' *R. leithii* he rightly had the laugh of me, for *R. leithii* it was, and it was there in its hundreds, and so I must now substitute the word *common* for the word *rare*.

The Matheran specimens were in breeding condition.

Bombay Natural History Society,
Bombay, C. McCANN.
14th June 1945.

19.—STRONG ODOUR EMITTED BY THE FUNGOID FROG (*RANA MALABARICA*).

In my articles on *Reptilia* and *Amphibia* I referred to *Rana malabarica* as the Fungoid Frog on account of the close resemblance of its colouring to one of the bark or wood attacking fungi. At the time when I gave it this name, I was not aware of its ability to enhance the camouflage by emitting a powerful fungoid odour. In most cases I had dealt with it in the open. When on a short visit to the Tansa Lake I found one of this species inhabiting the bathroom of the bungalow. I closed the doors of the room and tried to catch it. As soon as I chased it about I became aware of a strong fungus-like odour in the room: for a while I could not account for the smell. When I caught the animal the odour became stronger than ever, and so I immediately suspected the frog as the author of the scent. When I put it to my nose for confirmation, there remained no doubt. To make sure I asked my companions to verify my observations, they agreed that the frog did give out a strong smell.

The dorsal surface of *R. malabarica* is highly glandular; in this respect it is not the only species, and it will be interesting to know whether the other species are also capable of emitting an odour. In *R. malabarica* there appears to be little doubt that the odour coupled with its colouring and habits afford it protection from many a would-be enemy.

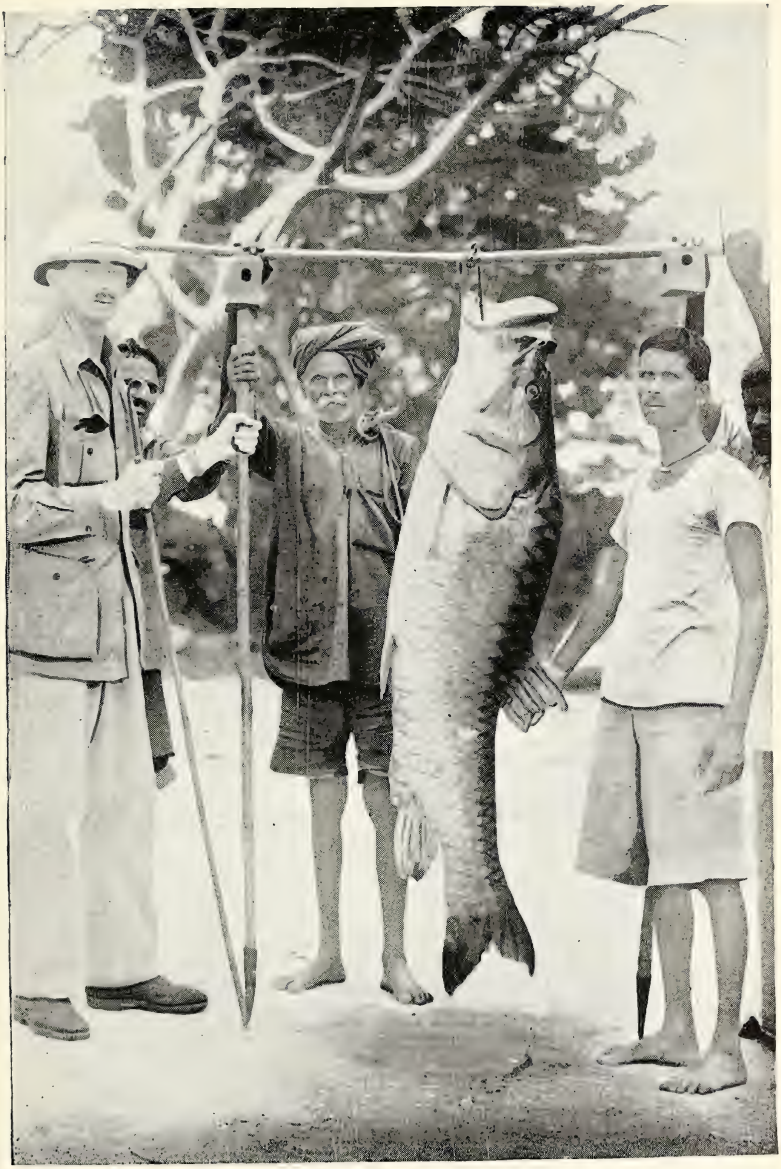
Bombay Natural History Society,
Bombay, C. McCANN.
20th May 1946.

20.—A RECORD MAHSEER.

(*With a plate*)

I enclose a photograph of a Mahseer I caught in the upper regions of the Cubbany River on 22-3-1946:—

Weight: 120 pounds.
Length: 66½ inches.
Girth: 41½ inches.
Mouth diameter: 10 inches.



A Record Mahseer (*Barbus tor*) from the Cubbany River, Mysore. 120 lbs.

The previous record was held by Colonel Rivett Carnac, caught in 1919:—

Weight: 119 pounds.
Length: 64 inches.
Girth: 42 inches.

The photograph was taken nearly 24 hours after the fish was caught.

As this is the record Mahseer, its publication will be of interest.

'BISSAL MUNTI',
MYSORE, J. DEWET VAN INGEN.
11th April 1946.

21.—ON THE BIONOMICS OF THE INDIAN SPRAT [*SARDINELLA GIBBOSA* (CUV. & VAL.).][1]

The Indian Sprat, *Sardinella gibbosa* (Cuv. & Val.) is a shoaling fish is of economic importants. It occurs in the Palk Bay and the northern portion of the Gulf of Manaar, throughout the year.[2] It is captured by means of shore seine nets, cast-nets and drift nets, and is chiefly sun-dried for export to the districts of Madura and Trichinopoly, and to Ceylon.

Size.—About one thousand specimens ranging in size from 5 to 16 cm. were examined. The commercial catches consist mainly of fish measuring 13 to 15 cm. long, but in April and May, large numbers of young sprats, 5 to 10 cm. in length, are attracted by night by torch-flares, into shallow waters, and baled into the canoes with hand nets. This indiscriminate fishing, irrespective of size, may have an adverse effect on the future fisheries. Sexual maturity is attained when the fish reaches a length of 14 cm.

Food.—The diet of the fish consists of plankton. The following organisms have been found in its stomach:—

Zooplankton.—Foraminifers, *Sagitta* spp., larval bivalves, *Creseis acicula*, *Spiratella* spp., *Nauplius* larvae, *Zoea* larvae, *Megalopa* larvae, copepods, *Leucifer hanseni*, *Rhopalophthalmus egregius*, and fish-larvae.

Phytoplankton.—*Coscinodiscus*, *Detonula*, *Fragilaria*, *Rhizosolenia*, *Thalassiothrix* and *Trichodesmium*.

Crustacean larvae, Pteropods and *Trichodesmium* form the chief food of this fish. Its fishery will, therefore, fluctuate in accordance with the paucity or profusion of the plankton. This fish is also one of the few which feed on the arrow-worms, *Sagitta* spp. The presence of foraminiferan shells in the stomach of specimens examined on certain days suggests that the fish fed on some foraminiferan ooze. Fish-larvae were never numerous, though they were frequently found in isolated specimens.

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[1] Part of work done by the author at the Krusadai Biological Station, Gulf of Manaar. Published with the permission of the Director of Industries and Commerce, Madras.

[2] Specimens of *Sardinella brachysoma* (Bleeker) and *S. sindensis*, Day, are also represented in the shoals in small numbers.

Spawning season.—The Indian Sprat has a single but prolonged spawning period, from September to February. Specimens with fully transparent eggs were obtained in December and January. Specimens partly or fully spent were seen in January and February.

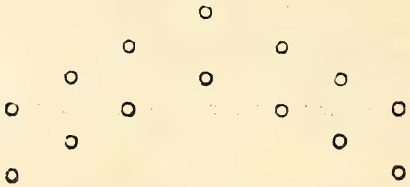
Eggs.—The ripe ova measure 0.56 to 0.60 mm. in diameter. Eggs obtained from the plankton measured 0.58 to 0.64 mm. in diameter. No attempt has been made to investigate the embryonic and larval development.

Enemies.—Specimens of the Indian Sprat have been recorded in the stomach-contents of the following fishes :—*Chirocentrus dorab* (Forskal); *Otolithus ruber* (Bl. Schn.); *Lactarius lactarius*, Cuv. & Val.; and *Sphyraena obtusata*, Cuv. & Val.

Fisheries Branch,
Department of Industries and Commerce, P. I. CHACKO.
Madras.

22.—MOVEMENT OF A GROUP OF INSECTS IN INDIA.

Near the town of Vyara, in the State of Baroda, Surat District, India, one day I noticed a small group of insects moving across the verandah floor. They seemed to be travelling in formation. At almost regular intervals all stopped and started simultaneously. There were approximately fourteen in the group and were arranged somewhat as follows:—



I judge the distance they covered between each start and stop was approximately one inch and the stops were of about one second duration. By observation no detection of a leader could be made for all seemed to start and stop simultaneously.

This kind of motion continued across the verandah, a distance of about six feet until an ant came into the formation. This confused them temporarily and they drew off into two divisions, but as the ant moved on they gradually came back together regaining their former rhythm and almost the same formation.

The insect was small in size, approximately that of a *Drosophila*, or a bit larger. Its shape was somewhat that of a grasshopper. In colour it was light grey or brown.

The above data is given from memory after an interval of five or six years but I think it is essentially accurate. The formation and motion of the group was so unique that it is difficult to forget.

EARL M. ZIGLER,
Missionary.

[The above note was sent to us by Dr. C. B. Williams, Head of the Department of Entomology, Rothamstead Experimental Station, Harpenden, Herts, for publication in the hope that some reader may be able to solve the problem and obtain specimens.—EDS.]

23.—A 'HERMIT' SPIDER.

About the middle of November last, I bought a number of botanical specimens from the Victoria Gardens. One specimen of *Memycelon edule* (*Melastomaceae*) had an open cocoon of a moth suspended from the branch and in it was lodged a beautiful yellow coloured striped spider which has been identified by the Zoological Survey of India as a female of a *Olios* sp. (The species could not be identified as the specimen was immature.) This to my mind is the first record of a spider inhabiting the cocoon of a moth, and so I hasten to record it in your *Journal.*

WILSON COLLEGE,
BOMBAY,
11th April 1946.

MOSES EZEKIEL.

[Spiders will often occupy any convenient cavity either as a retreat or, as a 'safe deposit' for their egg-cases. We have known them to occupy the 'bore holes' made by beetle larvae, Humble-bees (*Xylocopa*), and also the deserted cells left in the mud nests of mason wasps.—EDS.]

24.—ABNORMAL FLOWERING OF *CAREYA ARBOREA* ROXB. IN KHANDALA.

Careya arborea Roxb. is a very common tree about Khandala. Under normal circumstances, when the tree is in leaf, it is very conspicuous on account of the large size of its leaves; during the flowering and fruiting season, the size of the flowers and the disagreeable smell of the fruits cannot fail to draw the attention of even the least observant of botanists.

New leaves begin to come out at the beginning of the rainy season, when most of the over-ripe and evil-smelling fruits fall from the tree. The leaves are large and of a bright green colour, until the approach of the flowering season. Towards the end of February leaves slowly turn from green into various shades of brick red, and then gradually fall off, until there remains but the bare skeleton of the tree. Buds appear shortly after leaf-fall, some time in the middle of March; flowers may be seen from the second half of March onwards up to May.

On January 24, 1942, Mr. C. McCann and myself noticed a tree on Behram's Plateau near Khandala which showed very marked irregularity in its flowering rhythm. One branch, about one-third of the tree, was in full bloom and without a single leaf on; the rest of the tree was still fully clothed with all its leaves and did not show any signs of approaching flowering. On further examination we found that a large fire had been lit just beneath the branch in question, and that in consequence of the fire all the leaves had either been burnt or scorched; there resulted a general leaf-fall for that particular branch, the scorched or half-burnt leaves still covering the ground beneath the scorched branch. This particular branch was at the time loaded with flowers and buds, exactly like any other branch at the proper flowering time at the end of March.

The rest of the tree, which had not been affected by fire, only came into flower at the end of March of the same year; by which time the abnormal branch had *normal ripe fruits.*

Two explanations occur which may explain this abnormal behaviour of *Careya.* Possibly flowering and fruiting is induced by defoliation; or perhaps a considerable rise in temperature even for a short time may be responsible for the sudden flowering of the tree. These two points are easy enough to test experimentally, and may be taken up in the case of *Careya* and similar deciduous trees; I leave it to experimental plant physiologists to settle such an interesting subject, from the solution of which we may expect to get an insight into the agencies controlling the strange behaviour of some of our Indian deciduous trees.

ST. XAVIER'S COLLEGE,
BOMBAY, H. SANTAPAU, S.J.
12*th March* 1946.

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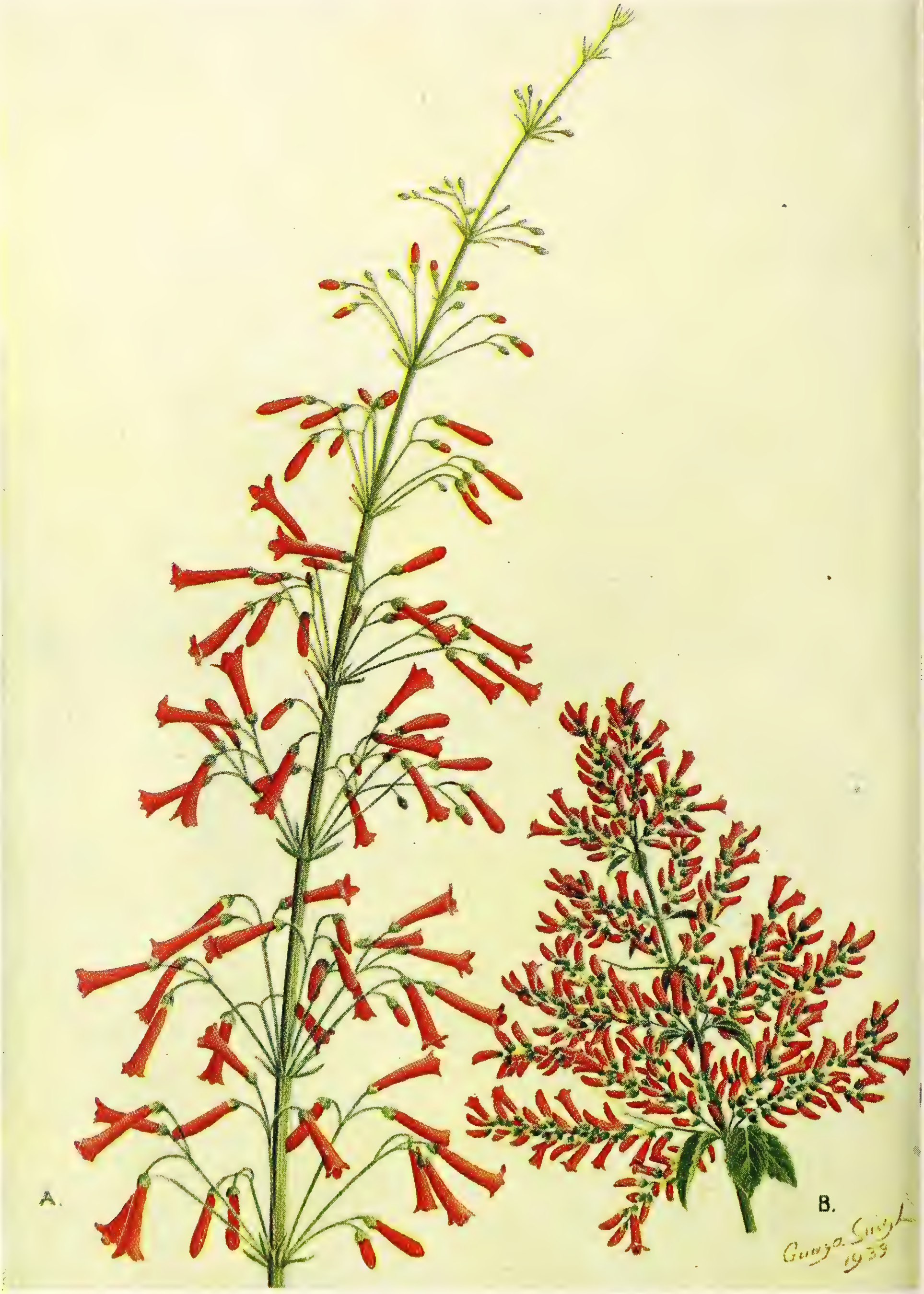
A.
B.
Ganga Singh
1939

THE CORAL PLANT.

A. Russelia juncea Zucc.

B. Russelia sarmentosa Jacq.

($\frac{3}{4}$ Natural Size.)

JOURNAL

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SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.

BY

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PART XXIV.

(*Continued from Vol.* 46, (194), p. 216).

(*With one coloured and* 4 *black and white plates.*)

Russelia Jacq.

(A genus belonging to the family *Scrophulariaceae* named in honour of Alexander Russel, an English physician and traveller, who died in 1768.)

A genus of shrubby species, Mexican in origin, which are favourite plants in Indian gardens on account of their showy flowers. The leaves are opposite or whorled, often reduced to scales. The flowers are red and are arranged in many-flowered cymes; calyx gamosepalous, cleft into five lobes; corolla-tube cylindrical with five lobes spreading at the mouth; stamens four; fruit a capsule.

KEY TO THE SPECIES.

Leaves scale-like or very small; corolla ¾ in. long.	... *R. juncea.*
Leaves well developed; corolla less than ½ in. long.	... *R. sarmentosa.*

JUN 17 1947

Russelia juncea Zucc. (*R. equisetiformis* Cham. et Schl.)

The Coral, Fountain or Fire-cracker Plant.

(*Juncea* means rush-like in Latin.)

Description.—A much branched shrub up to 6 ft. tall with glabrous, noded stems. Branches whorled, noded, smooth and glabrous, angled and grooved, nodding at the tips. The leaves are opposite or whorled, petioled, very small, ovate-lanceolate or linear-obtuse, sometimes spathulate, often crenate, up to ½ in. long, but usually reduced to mere scales at the nodes. In the latter case the whole task of photosynthesis is undertaken by the stems and branches.

The inflorescences are produced at the tips of whorled branches. The flowers are arranged on 2-3 flowered peduncles and are produced in profusion all the year round. Pedicels very slender, about ¼ in. long. Calyx 1/10 in. long, bell shaped, cleft into five, ovate-acute, imbricating lobes, greenish-brown or reddish in colour. Corolla tubular in shape, of a beautiful clear red colour, ¾ in. long, ending above in five rounded imbricating lobes, glandular inside at the base. Stamens four perfect, one rudimentary, inserted on the corolla near the base, reaching to the mouth. Anther cells divergent but at length confluent. Ovary seated on a fleshy disk, 2-celled, with many ovules on central placentas. Fruit a globose capsule.

Flowers.—Throughout the year. Does not set seed in this country.

Distribution.—Indigenous to Mexico. Very commonly grown in gardens in the plains throughout India.

Gardening.—An exceedingly common and at the same time a very graceful plant with long rush-like, ribbed, green stems and scarlet flowers. It seems to grow readily almost anywhere and is propagated by cuttings or division of the roots during the rains. It is quite suitable for growing in a rock garden and in hanging baskets.

The brightly coloured flowers and generous production of nectar are indications that the flowers are adapted to cross pollination by insects or birds. In this country, however, the *Russelias* apparently never set seed and are always propagated by other means.

In Dehra Dun the sun bird, *Cynnyris asiatica,* is a very frequent visitor to these flowers. Instead of doing its job in the proper way, this sun-bird bores a hole through the base of the corolla and steals the nectar and the transference of pollen from one shrub to another is avoided.

Russelia sarmentosa Jacq. [*R. coccinea* (Linn.) Wettst.]

(Sarmentosus means full of twigs or small branches, in Latin.)

Description.—An erect twiggy shrub reaching 5 ft. in height. Branches angular (often octangular) in cross-section, smooth and glabrous. Leaves well developed, often in fours, at the nodes,

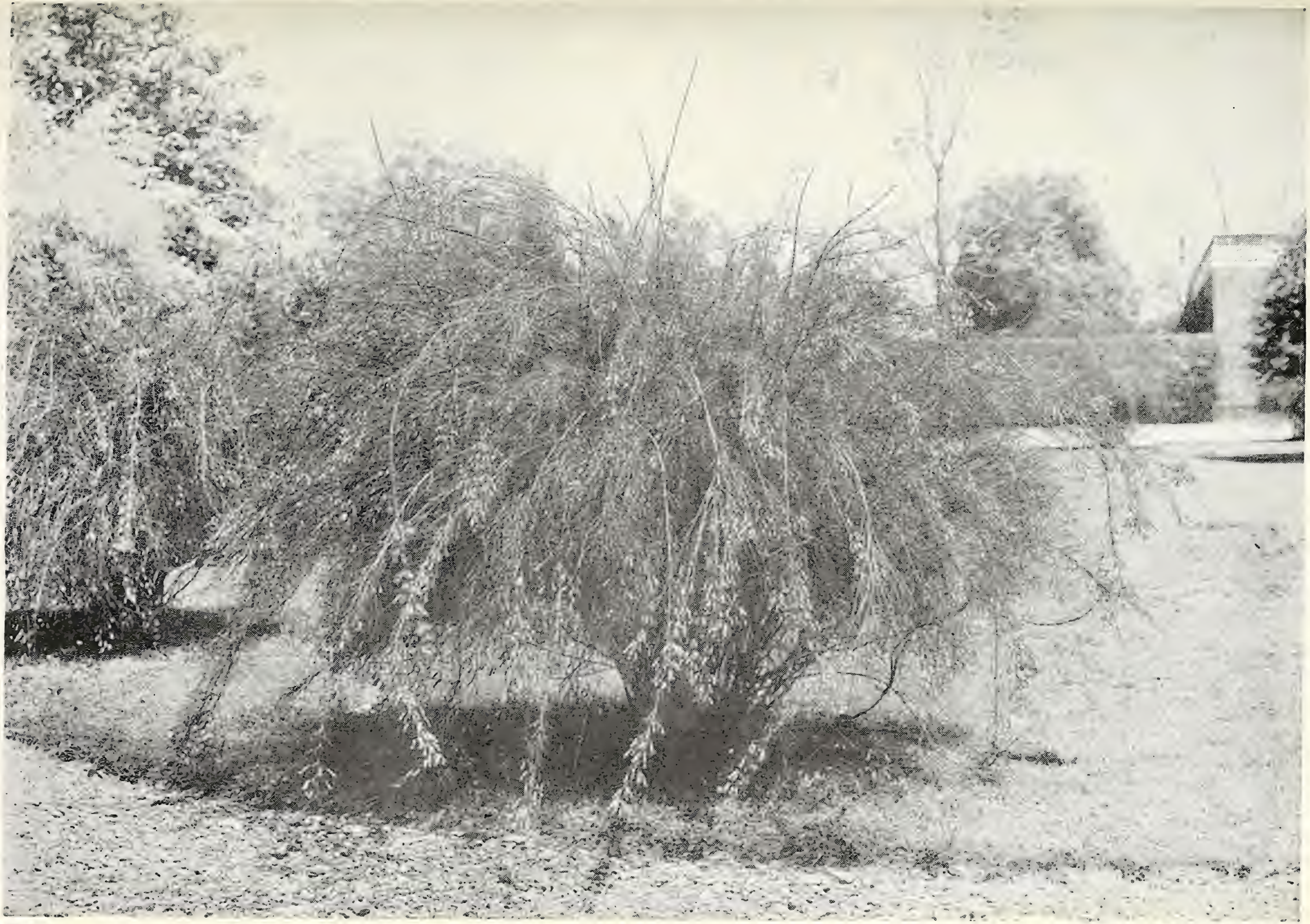

Photo by M. P. Kazan.

Russelia juncea Zucc.
New Forest, Dehra Dun.

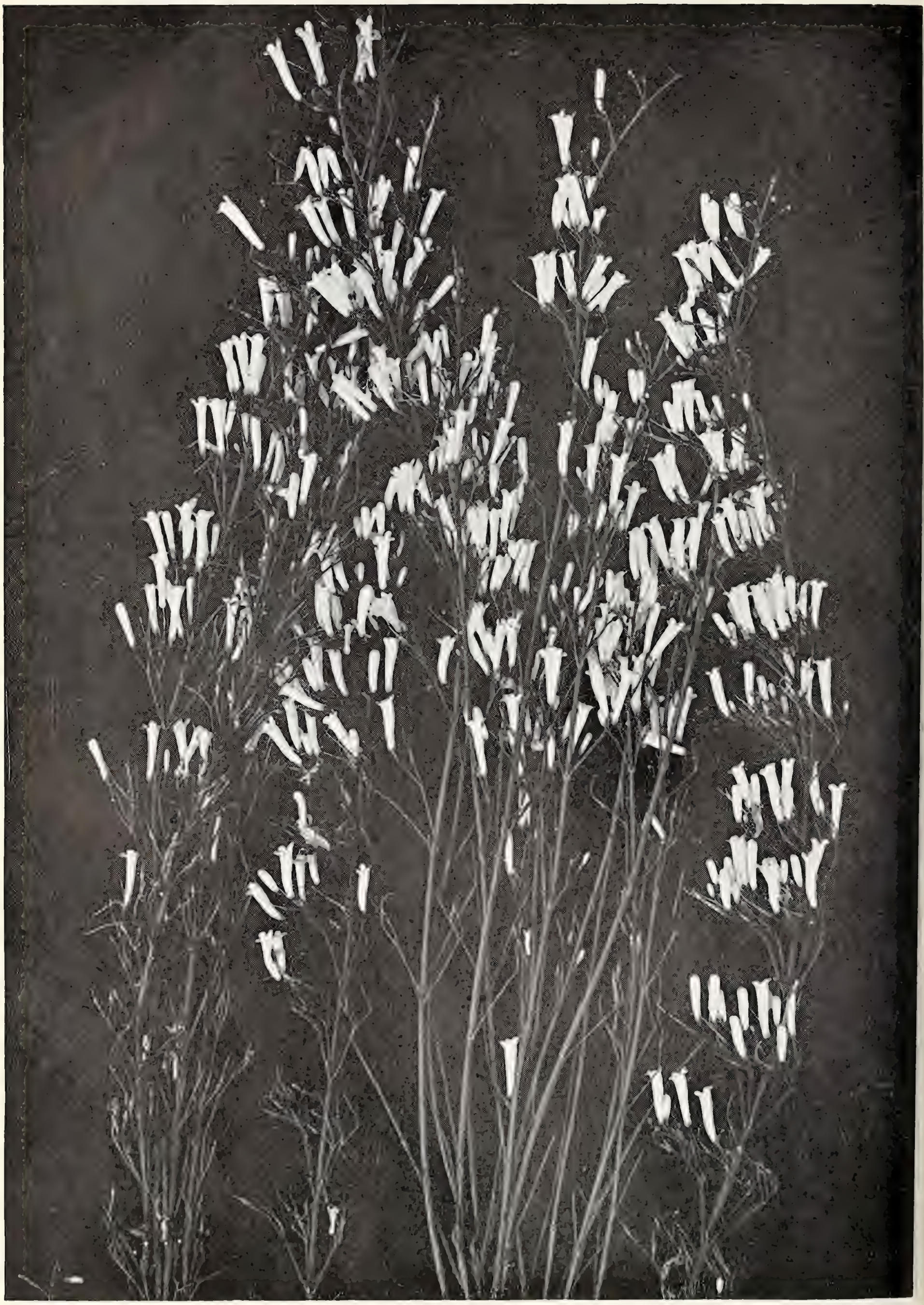

Photo by *M. B. Raizada*

Russelia juncea Zucc.
New Forest, Dehra Dun.

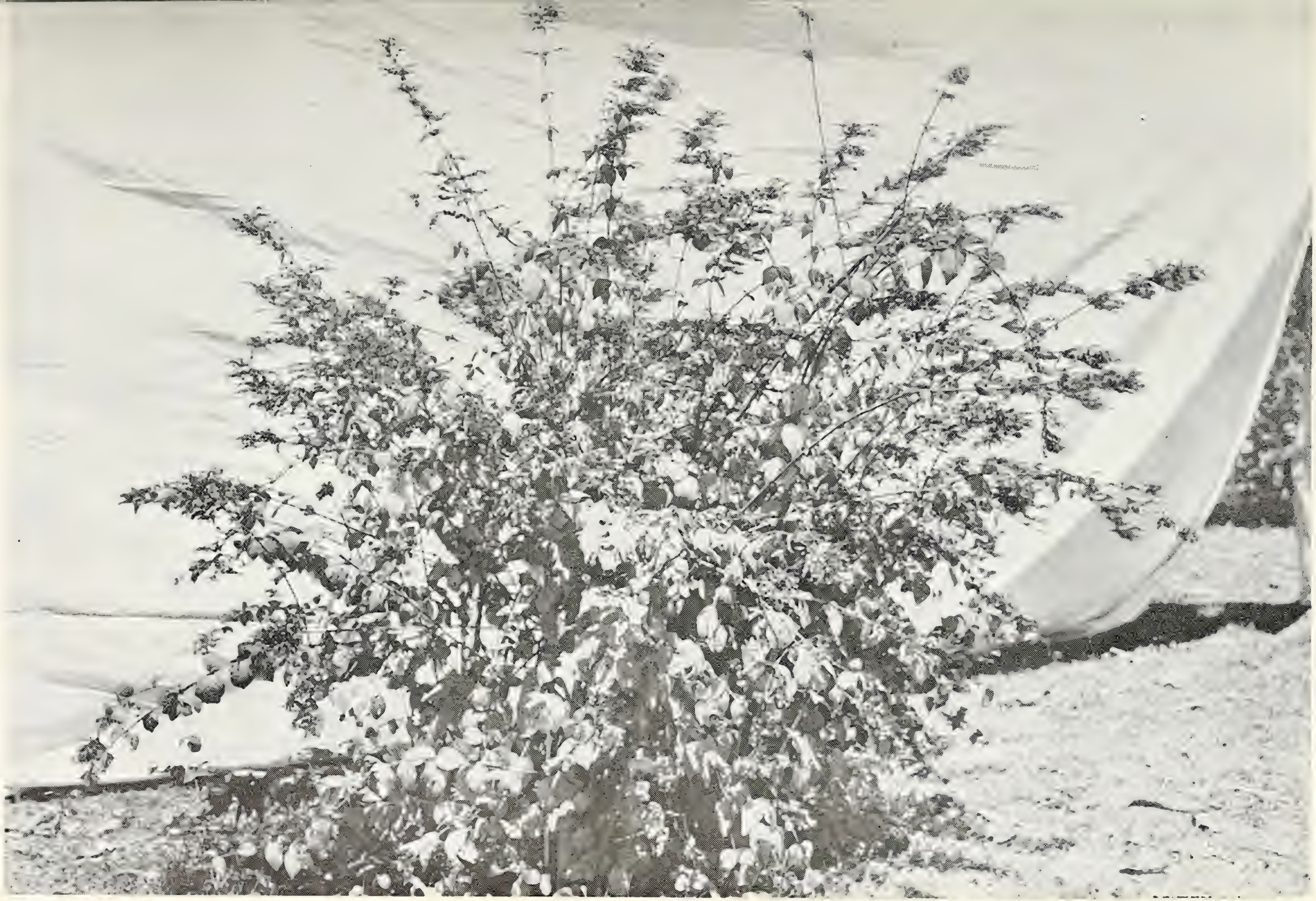

Photo by M. B. Raizada.

Russelia sarmentosa Jacq.
New Forest, Dehra Dun.

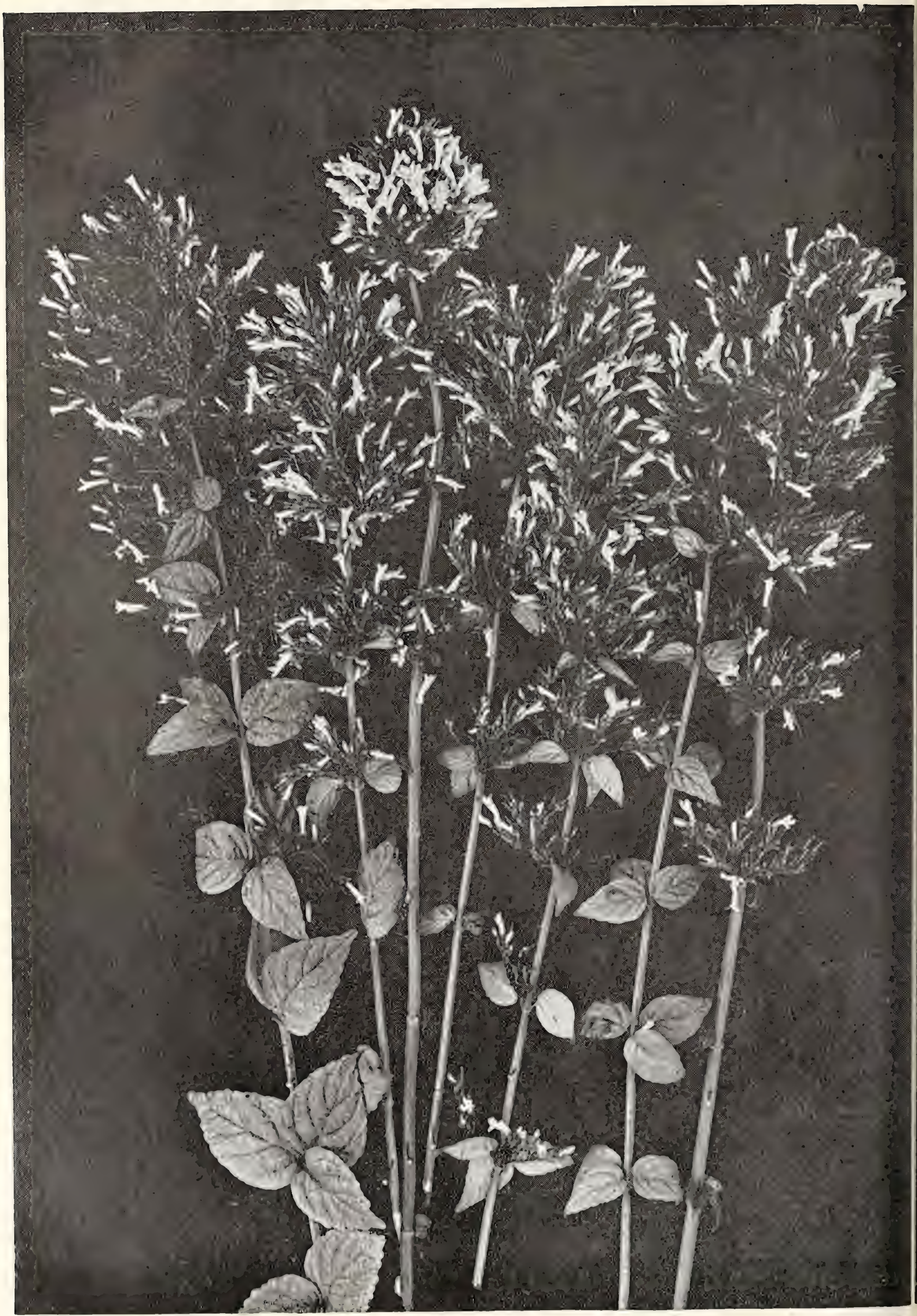

Photo by *M. B. Raiza*

Russelia sarmentosa Jacq.
New Forest, Dehra Dun.

petioled, ovate acuminate in shape, 2-4 in. long, coarsely toothed, with nerves deeply impressed on the upper surface, prominent beneath. Upper surface and petiole more or less covered with coarse short hairs, under surface hairy on the nerves only. The under surface between the nerves is deeply pockmarked with glandular pits.

Inflorescence in congested, bracteate dichotomous cymes. Bracts, bracteoles, peduncle and pedicel, sparsely covered with coarse hairs. Calyx divided almost to the base into 5 lanceolate-acuminate lobes, dark red in colour, sparsely hairy, $\frac{1}{12}$ in. long. Corolla red, tubular, divided above into 5 lanceolate-obtuse lobes, 1/3—1/2 in. long. Stamens four with widely divaricate anthers; filaments arising from the base of the corolla. Ovary seated on a disk. At the insertion of the stamens towards the base of the corolla is a narrow ring of club-shaped yellow glands. There is another line of glandular rod-shaped hairs running down from the mouth towards the base.

Flowers.—Most part of the year. Does not set seed in this country.

Distribution.—Indigenous to Mexico ascending to 8,000 ft., now grown in gardens throughout the tropics.

Gardening.—A handsome erect plant with deep scarlet flowers borne in crowded bunches along the stem. Propagated by division of the root as cuttings are less successful. This species is also known as *R. multiflora* Sims.

(*To be continued.*)

THE EARLY STAGES OF INDIAN LEPIDOPTERA.

BY

D. G. SEVASTOPULO, F.R.E.S.

PART XVI

(*Continued from Vol.* 46, p. 269).

HETEROCERA.

DREPANIDAE.

Callidrepana patrana Moore.

Head black, bifid above. Body dark olive green, the lateral and subdorsal areas of the thoracic somites, all the 4th, and a lateral blotch on the 9th somite, black. 5th somite with an olive tinged orange lateral spot. A lilac line at the base of the 3rd and 4th pairs of prolegs. Thoracic somites expanded laterally into bifid lobes. 5th to 8th somites with slight, double, dorsal humps, 11th somite with a dorsal tubercle. Anal somite produced into a long process, anteriorly thin and hyaline, then thickened and grey, the junction of the two parts olive. Legs black. Prolegs grey, the anal pair absent. The surface of the body shining as if oiled. Resting attitude with the head and forepart of the body curved along the posterior in a U and resembling a lump of wet snail excreta.

Pupa formed on a pad of black silk spun on a leaf and with a few strands of black silk spun across the posterior somites. Shape short and stout, the thorax keeled and with a dorsal keel on the 2nd to 4th abdominal somites. Colour bronzy black, a burnished blotch on each side of the thoracic keel.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 6-vi-44, pupated 9-vi-44 and a female emerged 17-vi-44.

Psiloreta obliquilinea Hamps.

Head purple black, divided above into two blunt points. Body blackish purple, a black lateral stripe on the thoracic somites, a black dorsal blotch on the 2nd and 3rd, a black dorsal line from 3rd to 7th, and a black lateral stripe from 5th to 9th somite, this latter straight below but coming to a point above on the 7th somite. 3rd somite with a short, backward-curved, dorsal process, a double dorsal point on the 7th somite and a black dorsal tubercle on the 11th. Anal somite produced backwards into a long, upcurved process with a white median ring. Venter olive black. Legs olive black. Prolegs purple black with the body immediately above expanded into a short flange. Anal prolegs absent.

Pupa in a thin cocoon in a rolled leaf. Dark chestnut brown, the 4th to 6th abdominal somites tinged laterally and ventrally with yellow. The pro-thorax and the anterior half of the meso-thorax covered with a white, mealy powder and with smaller lateral patches on the meta-thorax and 1st abdominal somite.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 4-vi-44, spun 12-vi-44 and a male emerged 22-vi-44.

SATURNIIDAE.

Samia cynthia Drury.

Hamps., *Fauna Brit. Ind.*, Moths, i, 16. 1892.
Seitz, *Seitz Indo-Austr. Bombyces*, x, 505. 1928.

Ovum—Very pale buff, longitudinally striped with darker. Micropyle a dark spot. Barrel-shaped, the ova deposited on their sides. Laid in small batches. Hatched 12-vi-44.

1st instar—Head black. Body yellowish. A black dorsal plate on the 1st somite. 2nd somite backwards with two transverse series of black dots on each somite and with a subdorsal, lateral and sublateral series of setiferous, black tubercles. Moulted 18-vi-44.

2nd instar—Head black. Body yellow. Each somite with a dorsal, subdorsal and lateral series of two black spots. A black setiferous tubercle between each series of spots and an additional sublateral tubercle. legs and prolegs black. Moulted 23-vi-44.

3rd instar—Head black. Body white with a dorsal, subdorsal and lateral series of two black spots on each somite. 1st to 10th somites each with a subdorsal and a lateral white, and a sublateral black, setiferous tubercle. 11th somite with one dorsal and a lateral white, and a sublateral black, setiferous tubercle. 12th somite with a transverse series of four, and 13th with two, white tubercles. Legs black. Abdominal prolegs white banded with black. Anal claspers black. Moulted 29-vi-44.

4th instar—Similar, but the head yellow with a black stripe on each side posteriorly and the legs and prolegs yellow. Moulted 3-vii-44.

5th instar—Head greenish yellow. Body very pale blue green covered with a white mealy powder. Tubercles as in previous instar but bluish in colour and the sublateral series with a black basal ring. The subdorsal and lateral tubercle on the 1st somite very small. Spiracles black with a small black spot immediately behind in addition to the paired black spots of the previous instars. A series of two black streaks on each somite below the sublateral tubercles. Legs yellow with a black spot at the base. Abdominal prolegs pale blue with an oblique black line. Anal claspers and flap yellow outlined with blue. 12th somite yellow dotted with black. Spun 10-vii-44.

The larvae are gregarious for the first two instars but separate in the third. A few larvae had a 6th instar, similar to the 5th except that the subdorsal tubercles on the 2nd to 10th and the dorsal one on the 11th somite were pale pink instead of blue.

Cocoon of tough, yellow-brown silk, the Eri silk of commerce, roughly spindle shaped, frequently spun in a leaf with the leaf-stalk covered with silk attaching it to the twig. Pupa pale chestnut brown, the thorax and abdomen darker on the dorsum. Abdominal somites contracted. Antenna sheath very large in the male pupae. Wing cases with the hind-wing projecting considerably beyond the forewing. A male emerged 4-viii-44.

Food-plant—*Lagerstroemia indica* L. I have also reared it on *Ricinus communis* in Calcutta.

Described from larvae bred from ova found at Tukdah (5,000 ft. Darjeeling District).

Hampson's description is 'Larva pale green or whitish, with one dorsal and two lateral pairs of darker spines. Cocoon pale brown.' Seitz describes the ovum as being white, slightly black-dotted, and states that the 'young larva is darker, then lighter yellow, yellowish green, and at last bluish green, all over covered with fine black dots, and with a dense white bloom on it...it also exhibits on each segment 6 coniform points.'

SPHINGIDAE.

Acosmeryx naga Moore.

Mell, *Biol. u. System. der Sudchin. Sphing.*, 225, pl. xviii, figs. 5, 6, pl. xxvii, fig. 13. 1922.
Seitz, *Seitz Indo-Austr. Bombyces*, x, 550. 1929.
Bell & Scott, *Fauna Brit. Ind.*, Moths, v, 292, pl. iv, figs. 1, 2, pl. xiv, fig. 14. 1937.

Penultimate instar—Head green, a central paler green stripe and a lateral yellowish stripe, which joins the subdorsal body stripe. Body green heavily speckled with yellow along the secondary segmental rings. A subdorsal yellowish stripe on the 1st to 3rd somites, which becomes lateral on the 4th somite and continues to the base of the horn, the colour of the stripe from the 5th somite backwards being white shading into deep pink above. A spiracular series of oblique yellow stripes. 4th somite expanded sublaterally into a slight lobe, the lobe yellowish edged with dark brown below. The spiracle on the 4th somite set in a black ring. Legs purple, the base black. Venter and prolegs green. Horn purplish at base grading into yellow at the apex, and covered with minute black tubercles, long and slightly upcurved.

Final instar—Very similar. Spiracles black with an orange pink rim. Legs dark brown. Horn shorter, down—curved, purple and tuberculate.

Pupa in a slight web amongst litter. Dark purple-brown, the lateral and ventral areas blotched and mottled with yellowish-buff and with a yellowish-buff crescent in front of the eye. The front edges of the abdominal somites punctate. Rear edge of the 7th abdominal somite strongly undercut, so that the succeeding segment appears much inset. 8th, and succeeding, abdominal somites deeply pitted. Cremaster black, a bulb ending in a stout spike with bifid tip. Spiracles black.

Food-plant—Virginia Creeper.

Described from a larva found at Tukdah (5,000 ft. Darjeeling District) 13-vi-44, pupated 26-vi-44 and a male emerged 29-vii-44.

Seitz' description is 'Larva very similar to that of *Ampelophaga*, dark green with a yellow subdorsal stripe and lighter or darker green, hardly noticeable oblique stripes below it. The 4 first rings are defined on the dorsum in the shape of a thoracal shield which is bordered by yellow and behind it by red-brown. The horn of the grown-up insect is small, green, curved below. On *Actinidia fulvicoma*, perhaps also on vine.' Bell & Scott give an excellent figure, except that the horn is shewn as a pale blue, in spite of the detailed description stating that it is purple. They also mention the occurrence of brown form, but I have not bred it.

Rhagastis albomarginatus Roths., *albomarginatus*.

Manson, *Journ. Bomb. Nat. Hist. Soc.*, xxvii, 753. 1921.
Seitz, *Seitz Indo-Austr. Bombyces*, x, 569. 1929.
Scott, *Journ. Bomb. Nat. Hist. Soc.*, xxxv, pl. ii, fig. 7. 1931.
Bell & Scott, *Fauna Brit. Ind.*, Moths, v, 479, pl. vii, figs. 1-3, pl. xv, fig. 11. 1937.

Penultimate instar—Head blue. Body green dotted with white along the secondary segmental rings. A dark blue-green dorsal line and a white subdorsal stripe on the thoracic somites and a series of oblique, white, lateral stripes on the abdominal, the last stripe not reaching the base of the horn. 4th somite with a protuberant ocellus, the pupil blue speckled with darker blue, the iris white and the whole rimmed with dark blue. Horn dark grey blue, down-curved, slightly compressed from side to side, tapering gradually from base and finally expanded into a knob and with a double row of black points along it. Legs, prolegs and anal flap greenish blue. Venter bluer green.

Final instar—Similar. The head more tinged with green. The ocellus with the pupil dark blue ringed with paler. Spiracles white. There is a considerable difference in the shade of green, some larvae being much more tinged with blue than others.

Pupa in a slight web among litter. Colour pale brown, the head, thorax and wing cases tinged with olive. An interrupted black ventral line on the abdominal somites, and a fuscous latero-ventral and dorsal stripe. Some fuscous shading on the spiracular area. Cremaster triangular, hollowed out below, and ending in two stout spines with bifid tips, and with two dorso-lateral black spines above. Tongue case projecting slightly ventrally. Legs and wing cases along the veins, with small raised points.

Food-plant—Cultivated Hydrangea (*Saxifragaceae*) and on an unidentified wild plant of the same order.

Described from a larva found at Tukdah (5,000 ft. Darjeeling District) 22-vi-44, pupated 1-vii-44 and a male emerged 23-vii-44.

Seitz' description is as follows:—'Larva grey, sham-eye on the 4th ring not so large as in the other larvae known of *Rhagastis*. On the sides very thick and long white oblique stripes, the last of which begins at the horn and extends to the last prolegs. The horn itself is slightly flawed and with an insignificant swelling above the base. On Dichroa febrifuga or Hydrangea and other plants.' He thus omits to mention the most distinctive feature of the larva, the marked protuberance of the ocelli on the 4th somite.

Rhagastis olivacea Moore.

Mell, *Biol. u. System. der Sudchin. Sphing.*, 324, pl. xii, figs. 23-27, pl. xix, figs. 29, 30. 1922.

Seitz, *Seitz Indo-Austr. Bombyces*, x, 569. 1939.

Bell & Scott, *Fauna Brit. Ind.*, Moths, v, 476, pl. vi, figs. 17, 18, pl. xv, fig. 7. 1937.

Ovum—Milky white tinged with green, ovoid. Laid singly on the underside of leaves of the food-plant. Hatched 28-v-44.

1st instar—Whitish green, unmarked. After feeding becomes darker and, in the case of larvae feeding on purple leaved balsam, tinged with purplish. Horn long and straight, black, the extreme base orange, the tip bifid. Moulted 1-vi-44.

2nd instar—Very similar to previous instar. Thoracic somites tapered and 4th somite somewhat swollen. 4th somite with an indistinct subdorsal ocellus consisting of a yellowish ring enclosing a bluish pupil. Traces of oblique white lateral stripes. Moulted 5-vi-44.

3rd instar—Similar to preceding with the markings all more defined. The ocellus with the pupil from front to rear a quarter blackish blue, a quarter dark blue and half blue-green, surrounded by a ring, white anteriorly and yellow posteriorly, edged with black. The secondary segmental rings speckled with white. Horn stouter, straight, purplish and tuberculate. Moulted 9-vi-44.

4th instar—Head green. Body yellow green speckled with yellow along the secondary segmental divisions. A dark dorsal line, and a white subdorsal stripe on the thoracic somites. A series of oblique white lateral stripes edged above with darker green from 4th somite backwards, the last stripe joining the base of the horn. The ocellus on the 4th somite with the posterior half of the pupil bright green containing two white dots, the anterior half very dark blue in front shading into bright blue behind, the surrounding ring white anteriorly and yellow posteriorly and edged with an indigo line. Horn deep yellow, stout, the apex pointed, minutely tuberculate. Legs, prolegs and venter green. Spiracles cream. Moulted 13-vi-44.

Final instar—Green form very similar to previous instar. The horn medium in length, slightly down-curved and purple-brown in colour. The brown form with the markings similar to the green form but with the ground colour a rich tobacco brown, speckled with white along the secondary segmental divisions. The ocellus with the pupil very dark olive, almost black. The lateral areas suffused with lilac. Horn olive brown. Pupated 25-vi-44.

Pupa in a slight cocoon amongst litter. Head, thorax and wing cases dark chocolate brown. Abdomen with the lateral area dark chocolate, the venter and dorsum paler brown streaked and speckled with darker. A dark dorsal stripe. Intersegmental areas olive green. Proboscis sheath projecting slightly frontally and ventrally, rounded. Leg sheaths with small raised points. Cremaster excavate below and ending in two forked spines. A female emerged 17-vii-44.

Food-plant—*Impatiens* spp. Bell & Scott add *Vitis* and Aroideae.

Described from larvae bred from ova found at Tukdah (5,000 ft. Darjeeling District).

Seitz' description is as follows:—'Larva leaf green, with a large yellow-edged sham-eye on the 4th ring; from this eye to the head a yellow longitudinal line. In the sides white oblique stripes alternating with green triangles.'

NOTODONTIDAE.

Somera viridifusca Wlk.

Head greyish white, the clypeus filled in with pale olive and with a pale olive streak on either side not reaching the vertex. An inverted J-shaped black lateral streak, which joins the subdorsal body stripe, with the front filled in with lavender and with a short cherry coloured bar below. Body with the dorsum yellow-green bounded by a white stripe and with a double yellow dorsal line. The white subdorsal stripe shading into yellow on the 1st somite, edged above with black on the 2nd, with a large cherry-red spot in it on the 7th, in some examples with smaller cherry-red spots on the 3rd, 5th, 6th and 8th somites, and edged above with purplish shading into black posteriorly on the 12th and 13th somites, the anterior and posterior portion on all somites tinged with yellow. The area below the subdorsal stripe green. Spiracles cream, edged behind with black and with a white spot above and to the rear. Venter, legs and prolegs bluer green.

Pupa subterranean. Dark purple brown and very shiny. Apex of abdomen blunt and armed with two fine spines. Wing cases short.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 21-vi-44, buried 22-vi-44 and a female emerged 3-vii-44.

NOCTUIDAE.

Acronicta indica Moore.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xlii, 755. 1941.

Examination of further larvae found at Tukdah (5,000 ft. Darjeeling District) in May 1944 has revealed a small error in the above quoted description. The triple subdorsal tuft of black hair is placed on the 4th somite, not on the 3rd as originally stated.

Food-plant—Also on Rose, *Salvia* sp., *Melastoma normale* Don.

Moma champa Moore.

Gardner, *Indian Forest Records,* vi, 265. 1941.

Head olive brown. Body dark slate blue, a dorsal and subdorsal terra-cotta line, the area between from 4th to 10th somite speckled with white. Each somite laterally with an anterior oblique terra-cotta stripe and a posterior erect one. A subdorsal series of tubercles each bearing a few long dark hairs, the tubercles on the 2nd and 11th somites much larger, the former clothed with golden brown, the latter with dark brown pubescence. An interrupted white sublateral stripe with a fringe of snow white hair. 1st somite with a lateral tubercle with a pencil of long white hairs. Spiracles white. Venter blackish with a median purple stripe. Legs blackish. Prolegs pink.

Cocoon of whitish silk and spun among leaves. Pupa shining, dark red-brown, the intersegmental areas olive. A pale yellow-brown central spot on the head.

Food-plant—Rose. Gardner gives *Pyrus communis* and *Prunus communis.*

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 4-vi-44, spun 11-vi-44 and a male emerged 28-vi-44.

This larva differs considerably from the figure of that of *Moma ludifica* L., given by Hampson (1913, *Cat. Lep. Phal.*, xiii, 336), which shews a larva with longish subdorsal tufts of hair and the fore- and hind-part raised. My larvae all rested gripping with the true legs, abdominal prolegs and anal claspers.

Polia (*Hadena*) *consanguis* Guen.

Head brownish olive, minutely reticulated with darker, and with a dark stripe outlining the median suture and clypeus. Body blackish grey, traces of a darker dorsal line and a paler subdorsal stripe, edged below with an interrupted black line. A pinkish-buff sublateral stripe, between which and the subdorsal stripe there are three indistinct dark-edged paler lines. Spiracles black. Venter, legs and prolegs blackish grey.

Pupa subterranean in a slight earthen cocoon. Chestnut brown, the abdominal somites with the anterior edge darker and punctate. Wing-cases paler. Cremaster a double, divergent spine.

Food-plant—Grasses.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 29-v-44, buried 4-vi-44 and a female emerged 24-vi-44.

Tiracola plagiata Wlk.

Moore, *Lep. Ceyl.*, iii, 34, pl. 148, fig. 1a. 1884-7.
Hamps., *Fauna Brit. Ind.*, Moths, ii, 283. 1894.
Hamps., *Cat. Lep. Phal.*, v, 259. 1905.
Warren, *Seitz Indo-Austr. Noctuidae*, xi, 74. 1913.

Head red brown, darker frontally. Body black, minutely streaked and speckled with grey and with the dorsal area tinged with olive. A black dorsal line, most distinct on the thoracic somites. A very pale greenish-yellow lateral blotch on the 4th to 6th and 10th to 11th somites, in some examples with traces of a cream lateral stripe between. A few colourless hairs arising from minute warts, a dorsal pair on the 4th, 5th and 6th somite rather larger than the others. 11th somite humped and with two large dorsal warts. Legs red brown ringed with black. Venter and prolegs dark olive tinged with reddish. At the beginning of the instar the ground colour is distinctly black, as the instar progresses it becomes more and more tinged with olive.

Pupa subterranean in a slight earthen cocoon. Dark chestnut brown, a dorsal line and the intersegmental areas darker. Cremaster a fan of four stout spines, with two more slender spines above.

Food-plant—Polyphagous, eating a large number of unidentified low plants and shrubs. All previously published descriptions give *Emilia* as the food-plant.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 4-vi-44, buried 10-vi-44 and a female emerged 3-vii-44.

All published descriptions seem to be based on Moore's which is as follows:—'Larva dull violet-brown; with a few fine dorsal hairs, a few scattered grey dots, and a sublateral pale olivaceous band from fourth segment; head small; head and legs violet grey;

twelfth segment conical. Pupa dark red.' The figure is most unlife-like and shews a dark purple larva with a sublateral pale olive stripe edged above by a white line from the 4th somite backwards, and with a brown head and legs.

Conservula indica Moore.

Head pale brown, reticulated with darker. Body golden brown minutely speckled with darker. An orange dorsal stripe, a dorsal series of darker brown V-shaped marks, and a subdorsal series of slightly oblique orange stripes. A white spiracular line, edged below narrowly with orange. Spiracles white ringed with dark brown. Venter and prolegs golden brown. Legs pinkish.

Pupa subterranean in a cocoon of brownish silk covered with earth. Bright chestnut brown, shining. Cremaster two stout, outwardly curved, spines with some smaller spines ventrally.

Food-plant—Bracken.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 22-v-44, buried 28-v-44 and a male emerged 21-vi-44.

Warren (1913, *Seitz Indo-Austr. Noctuidae,* xi, 155) describes the larva of the closely allied *C. v-brunneum* Guen. as spinning up in a slight cocoon among the fronds. My larvae quite definitely buried.

Callyna contracta Warr.

Head black, edged behind with yellow. Body black. 1st somite with a subdorsal yellow streak joining a transverse yellow stripe and sublateral yellow speckling. 2nd somite with two transverse yellow stripes which join on the lateral area, and sublateral yellow reticulations. 3rd somite with a transverse yellow line anteriorly. 4th somite with two white transverse stripes with a white line, with two streaks behind it, between them. 5th to 7th somites each with two transverse white stripes with two streaks between them. 8th somite with the two transverse stripes only. 9th somite backwards transversely striped with yellow, three stripes per somite. A yellow lateral line with white and yellow streaks above it. Venter black, minutely streaked transversely with yellow and whitish. Legs black. Prolegs yellow with a black central streak. A few longish colourless hairs.

Pupa subterranean in a tough cocoon covered with earth. Mahogany brown, the venter paler. Thorax with a slight dorsal ridge. Cuticle punctate. Cremaster a double outcurved spine, with shorter straight spines below.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 25-v-44, buried 28-v-44 and a female emerged 27-vi-44.

Clethrophora virida Heyl.

Pupa in a long spindle-shaped cocoon of pure white, tough, papery silk, longitudinally wrinkled. Pale green, a broad, dark brown, dorsal stripe on thorax and abdomen. Apex of the abdomen blunt. Both the cocoon and pupa are very Lasiocampid-like in appearance, the cocoon could quite easily pass for that of a *Cosmotriche* but for lack of the protruding larval hairs.

Described from a cocoon found at Tukdah (5,000 ft. Darjeeling District) 15-v-44, from which a female emerged 29-v-44.

Sypna curvilinea Moore.

Head yellow green. Body yellow green, minutely dotted with reddish, and with a white dorsal stripe tinged with purplish on the 12th somite. Skin between the head and first somite black but only visible when the head is extended. 1st somite with two transverse series of white dots. 2nd and 3rd somites with a transverse series of four white dots. 4th with two subdorsal and a lateral, and a larger subdorsal dot between it and the 5th somite. 5th to 9th somites each with two subdorsal, two lateral and two sublateral white dots. 10th with two subdorsal and three lateral. 11th with two subdorsal and one lateral. Venter green with a double whitish stripe. Legs pinkish. Prolegs orange, the first pair much reduced. Spiracles reddish with a white centre.

Pupa in a spun together leaf. Very dark brown, almost black, the wing-cases and intersegmental areas paler. Cremaster a bunch of hooked spines.

Food-plant—*Rubus* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 18-v-44, spun 22-v-44 and a male emerged 13-vi-44.

Adris tyrannus Guen.

Head olive black. Body purple-black with a dull purple-pink subdorsal stripe, paler at the edges and darker centrally, and a similar lateral stripe, most marked on the thoracic somites and interrupted by the ocelli and lateral markings on the 9th and 10th somites. 1st somite with two bright blue dots at the base of the leg, two sublateral yellow dots, the anterior one with a blue dot above it, and a lateral blue dot. 2nd somite with an anterior transverse series of six and a posterior series of eight blue dots, one at the base of the leg and a sublateral, yellow, open ring. 3rd somite similar but with the yellow ring replaced by a yellow streak. 4th somite with a subdorsal triangle of three blue dots, a large yellow lateral spot, a sublateral triangle of three blue dots, with an irregular yellow spot below and two blue dots below that. 5th and 6th somites each with an anterior and a posterior subdorsal blue dot, a large lateral ocellus consisting of a black pupil containing a blue crescent below, surrounded by a ring, wide and cream anteriorly and narrow and orange behind, a sublateral triangle of three blue dots with a few minute yellow streaks and two more blue dots below. 7th and 8th somites each with a subdorsal triangle of three blue dots, rather paler than the others, with a yellow streak between the basal pair, four sublateral blue dots with a reticulated yellow marking and one blue dot at the base of the proleg. 9th somite similar but the yellow reticulations extending over the lateral and sublateral area, enclosing the blue dots and speckled with black. 10th somite with a subdorsal yellow streak joined to the patch on the 9th somite, a subdorsal triangle of three blue dots and two slightly larger lateral and two sublateral blue dots with yellow streaks between. 11th somite humped, the top of the hump crimson, with four blue dots and a yellow blotch at the side, an anterior subdorsal, three lateral and two subdorsal blue dots. 12th somite with a double dorsal blue dot, a lateral triangle of three and a sublateral pair, with an elongate yellow ring between, and a cream mark posteriorly extending to the side of the anal flap. Venter, legs and prolegs black, the first pair of prolegs aborted.

Pupa in a slight cocoon spun between leaves. Very dark mahogany brown, the cuticle minutely punctate but shining, the wing-cases rugose. Apex of the abdomen longitudinally wrinkled. Cremaster a bunch of hooked spines.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 18-v-44, spun 26-v-44 and a male emerged 14-vi-44.

Plusiodonta coelonota Koll.

Moore, *Lep. Ceyl.*, iii, 75, pl. 153, fig. 1a. 1884-87.
Hamps., *Fauna Brit. Ind.*, Moths, ii, 578. 1894.

Young larva—Head deep yellow. Ground colour of body greenish grey, 1st somite with a black subdorsal spot, 2nd and 3rd each with a black lateral spot, 4th to 12th somites each with a black subdorsal spot. Legs and prolegs pale grey, the first two pairs of prolegs obsolete.

Full grown larva—Head orange. Body blackish. 4th somite backwards streaked and speckled with greyish blue. 4th somite with a lateral white spot, 5th with white reticulations dorsally, 7th somite with the dorsal area grey, the rest whitish, 11th somite with a white lateral blotch.

Cocoon of whitish silk covered with fragments of chewed leaf, shuttle-shaped. Pupa dark purple brown. The cremaster a broad transverse ridge with a slight point at each end.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 14-vi-44, spun 15-vi-44 and a male emerged 1-vii-44.

Moore's description is 'Larva with twelve legs; violet-black, with grey speckles and streaks; a purplish patch on eighth and twelfth segment; head reddish. Pupa narrow, purplish-black, enclosed within an elongated purplish-grey streaked cocoon. Feeds on *Cocculus macrocarpus*.' The figure shews a grey-speckled blackish larva with large white patches. Hampson's description is as follows:—'Purplish black with grey specks and streaks; the 7th and 11th somites with pinkish patches; head reddish'.

Dichromia quadralis Wlk.

Head yellow, two transverse series of eight black dots above the jaws, above which is a larger central spot, and then two further series of four and two. Body dull green, a blackish dorsal and lateral stripe, the latter edged above and below with yellowish. The 4th to 6th and 11th somites banded transversely with blackish. 1st somite with two transverse series of six black dots, 2nd and 3rd each with four and a sublateral triangle of three. 4th to 11th somite with an anterior and posterior subdorsal black dot and a sublateral triangle of three. 12th somite with an anterior subdorsal dot and a posterior transverse series of six. Anal flap with two anterior and six posterior black dots. All the black dots giving rise to colourless hairs. Legs black. Prolegs green, the first pair obsolete, with a black spot at base and an external black streak. Anal claspers yellowish dotted with black. Venter green with transverse series of black dots.

Pupa in a spun together leaf. Pale chestnut brown. Head with a median black spot, a bar on the eye and a spot above it. Pro-thorax with a subdorsal black spot. Meso-thorax with a subdorsal black lunule, a lateral streak and a sublateral spot. Metathorax and abdomen with black transverse bands. Leg and wing cases streaked with black. Cremaster a bunch of hooked spines.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 8-vi-44, pupated 11-vi-44 and a male emerged 23-vi-44.

GEOMETRIDAE.

Dindica polyphaenaria Guen.

Head green, rectangular and slightly notched above. Body leaf green minutely shagreened with white points. A subdorsal whitish-yellow line and a lateral white line from the base of the third pair of legs backwards. Very obscure oblique white lines between the subdorsal and lateral lines. A narrow yellowish ventral stripe with a series of oblique yellow lines between it and the lateral line. 1st and 2nd pairs of legs green, the 3rd pair pink with the base dark brown. Prolegs green. Anal flap produced into a blunt point. Spiracles dark red.

Pupa in a spun together leaf. Dull olive brown, the wing cases greener. Head and prothorax each with a small double dorsal tubercle. A lateral pit between the 4th and 5th abdominal somites. Cremaster a stout spine.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 24-vi-44, spun 28-vi-44 and a female emerged 10-vii-44.

Iodis argutaria Wlk.

Head green, bifid above, the points purplish. Body green, suffused on the dorsum with purple, the suffusion most pronounced on the intersegmental divisions. Shape very long and slender, the anal flap produced to a point.

Pupa in a slight web among leaves. Bright leaf green, the dorsum slightly darker. Head truncate.

Food-plant—*Rubus* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 22-v-44, spun 27-v-44 and a female emerged 10-vi-44.

Osteosema sanguilineata Moore.

Head greenish, rounded. Body curiously knobbed giving the impression of a catkin covered with small galls. 1st somite with a transverse series of six very small knobs anteriorly and a larger subdorsal and lateral knob posteriorly. 2nd somite with a double dorsal, a very large subdorsal and a lateral knob. 3rd somite similar. 4th with three small dorsal knobs, one anterior and two posterior, a very large subdorsal, a lateral and a sublateral. 5th to 8th with a divided dorsal knob anteriorly and a double one posteriorly, a large subdorsal, a lateral and a sublateral. 9th and 10th with a small paired dorsal knob, a large lateral and a sublateral. 11th somite with a transverse series of four large knobs. Colour greenish, the knobs, particularly the large ones, more or less tinged with purplish. Traces of a dark dorsal, lateral and ventral line. Legs and prolegs greenish.

Pupa in a leaf spun together with thick strands of brown silk. Head truncate, shape fairly stout. Colour green, the wing cases darker. A dorsal series of minute purple specks on the abdomen and a lateral series of small raised purple spots. The veins of the wing cases raised.

Food-plant—*Maesa chisia* Don.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 2-v-44, pupated 14-v-44 and a female emerged 3-vi-44.

Cidaria delecta Btlr.

Head yellow green surrounded by a brownish ring. Body green, a blackish dorsal and a white subdorsal line, the latter with two black specks above it on each somite from 4th to 8th. A diffused pinkish sublateral stripe. Venter with a blackish median line and transverse series of white specks. Legs green, the 3rd pair tinged with pink. Prolegs green tinged with pink. Those larvae that feed on creeper with pink leaves are suffused with pink, the dorsum from 1st to 9th somite less than the rest of the body.

Pupa in a spun together leaf. Yellow green, minutely streaked with blackish and suffused with golden. A blackish dorsal and ventral line and a dark V outlining the meso-thorax. A subdorsal series of black dots.

Food-plant—Virginia Creeper.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 8-vi-44, spun 13-vi-44 and a male emerged 25-vi-44.

Cidaria aurigena Btlr.

Head green, with a black-brown central line. Body transparent blue-green, a dark pulsating dorsal line and a dark line which appears subdorsal when seen from above and lateral when seen from the side. A white spiracular line. Venter transparent green with a dark median stripe due to the contents of the intestines shewing through. Legs and prolegs green. Shape tapered from head to anal somite.

Pupa in a spun together leaf. Pale green, the thorax and wing cases a transparent, glassy green. Cremaster a spike armed with hooked brown spines.

Food-plant—*Impatiens* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 28-v-44, spun 1-vi-44 and a female emerged 12-vi-44.

Cidaria silaceata Schiff.

Head yellow green. Body purple, each somite with a median and posterior transverse series of minute white specks on the dorsum and venter. A dark lateral line edged below with paler. Venter with a median whitish line. Legs yellowish green. Anal claspers with an anterior white stripe, posteriorly tinged with greenish. Anal flap purplish tinged with green.

Pupa in a spun up leaf. Green, the dorsum on the abdomen tinged with pink and with a sprinkling of minute black specks. Venter with a black streak. Cremaster pink, triangular, ending in a bunch of hooked spines.

Food-plant—*Impatiens* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 18-v-44, spun 24-v-44 and a male emerged 7-vi-44.

Photoscotosia miniosata Wlk.

Sevastopulo, *Journ. Bomb. Nat. Hist.,* xl, 691. 1939.

Among a number of normal larvae collected at Tukdah, one had the green colour replaced by golden brown, the dorsal markings almost obsolete.

Usual mode of pupation is in a subterranean cocoon, not in a spun up leaf as previously described.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 20-v-44, pupated 23-v-44 and a male emerged 7-vi-44.

Phthonoloba decussata Moore.

Head very slightly bifid, the prominences blunt. Colour of head and body a clear orange pink, the intersegmental areas darker and with traces of a dark dorsal line. Venter whitish. Legs and prolegs pale orange pink. Anal claspers each with a backward pointing tooth.

Pupa in a slight web among litter. Bright, pale, orange brown, the wing cases tinged with green.

Food-plant—Rose.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 30-iv-44, pupated 5-v-44 and a female emerged 19-v-44.

Callabraxas amanda Btlr.

Head green, suffused with pale mauve and minutely speckled with black. Body mauve, minutely speckled with white, the dorsal area increasingly suffused with green from the 7th somite backwards, the lateral area from the 7th somite backwards yellow green. Venter green from the 9th somite backwards, 2nd and 3rd somites each with four black dots arranged in a diamond dorsally, 4th to 7th with three and 8th somite with two only, but larger. Prolegs green. Legs mauve.

Pupa in a spun together leaf. Pale yellowish green, the wing cases yellow. Pro- and meso-thorax each with two transverse series of minute black specks. 2nd to 6th abdominal somites with an interrupted black dorsal stripe. The subdorsal area with two lines of black dots. A double lateral series of black streaks and dots. An interrupted black ventral stripe on the 5th and 6th abdominal somites. Cremaster and terminal somite black, cremaster a stout spike ending in a double reddish spine.

Food-plant—An unidentified plant belonging to the Saxifragaceae.

Descibed from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 26-v-44, spun 4-vi-44 and a female emerged 24-vi-44.

Peratophyga aerata Moore.

Head brown, some examples with a broad, blackish, central stripe. Body blackish, some examples tinged with green. A subdorsal line of white dots on 1st to 3rd and 9th to 12th somites, 5th and 6th somites with a white subdorsal spot anteriorly. A buff lateral stripe from 5th to 8th somite. Venter blackish with a dotted white central line. Legs black. Prolegs buff. Shape short and stout.

Pupa in a slight cocoon among litter, possibly subterranean in nature. Dark reddish brown, the thorax and wing cases dark olive. 6th and 7th abdominal somites with a transverse raised ridge. Cremaster a stout spine.

Food-plant—*Hypericum* sp.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 16-vi-44, pupated 18-vi44 and a male emerged 1-vii-44.

Eurytaphria bisinuata Hamps.

Head small, green with a blackish V-shaped mark. Body green, the intersegmental areas silvery, with a dark dorsal stripe tinged with purple on the thoracic and posterior somites. 2nd and 3rd somites each with a dark crimson lateral speck. 5th to 8th somites each with a double sublateral dark crimson speck. Legs, prolegs and venter green. Spiracles set on black spots.

Pupa in a slight earthen cocoon. Pale chestnut, tinged with olive. The wing cases olive green. Cremaster a short, bifid-tipped spine.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 10-v-44, buried 15-v-44 and a female emerged 27-v-44.

Ectropis (*Boarmia*) *bhurmitra* Wlk.

Head triangular, flattened above, pale brown with a darker lateral line. Body dark brown. 1st to 4th somites with a darker subdorsal line, 5th somite with a darker dorsal V-shaped mark with a pale buff streak in front of each arm, 7th somite with a darker subdorsal line, edged below with paler. A pale diamond-shaped dorsal blotch on the 8th somite. 11th somite slightly humped and with a double, dorsal tubercle, a subdorsal pale mark ending at each tubercle with a very dark brown bar below. A pale streak along the abdominal proleg. Venter dark brown with a whitish median line. Legs dark brown. Shape fairly short and stout.

Pupa subterranean without any perceptible cocoon. Dark reddish chestnut, the wing cases olive. Cremaster a stout spike ending in two spines.

Food-plant—*Maesa chisia* Don., *Symplocos* sp., *Melastoma normale* Don. and a number of unidentified shrubs.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 14-v-44, buried 15-v-44 and a female emerged 4-vi-44.

Psyra spurcataria Wlk.

Head olive brown. Body olive brown, blotched and mottled with darker. Dorsal area of the 1st to 4th somites greenish with a dark median stripe. 5th and 6th somites dorsally bright chestnut speckled with canary yellow, the anterior edge of this area defined by a brown V-shaped mark with the apex directed forward. 7th somite with a greenish yellow triangular dorsal mark, the posterior portion of the somite dark brown, which continues as a narrowing dark brown dorsal stripe on the 8th and 9th somites after which it divides and runs to the anterior edge of the anal clasper. Venter tinged with greenish. Legs and prolegs olive brown. There is considerable variation in colour, some examples having the ground colour distinctly olive green and the dorsal marking on the 5th and 6th somites bright yellow green speckled with red brown, the dorsal mark on the 7th somite yellow green. One larva, which unfortunately was parasitised and so I cannot be absolutely sure of its identity, had the ground colour dull grey and the dorsal markings obsolete with the exception of a V on the 5th somite composed of brown-ringed white dots and traces of a similar V on the 6th somite. Shape peculiar and distinctive, the 5th somite anteriorly with a very short dorsal tooth, 6th somite with a long dorsal process bifid for the greater part of its length, and 7th somite with a short subdorsal tooth. Resting attitude with the head and first two somites folded back along the dorsum, the 2nd pair of legs holding the support and the 3rd pair the body near the abdominal prolegs, and the body humped so that the head is tucked up against the dorsal tooth on the 5th somite and the process on the 6th somite stands erect.

Pupa in a slight cocoon among leaves, possibly amongst litter in nature. Very dark olive brown, almost black, the intersegmental areas paler. Wing cases with the veins raised. Cremaster a stout spin, the apex bifid.

Food-plant—Rose and a number of unidentified shrubs.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 15-v-44, spun 21-v-44 and a female emerged 8-vi-44.

Fascellina plagiata Wlk.

Head purple brown, slightly bifid above. 1st and 2nd somites dark chestnut, slightly paler laterally. 3rd and 4th somites dark chestnut dorsally with a subdorsal lilac line, olive brown laterally and paler chestnut sublaterally. 5th somite olive brown, a subdorsal lilac line, the sublateral area pale chestnut, and with a bright orange-brown dorsal projection with the tip bifid. 6th somite with the dorsal area lilac speckled with olive, shading through olive into pale chestnut sublaterally, and with a similar dorsal projection. 7th somite chestnut dorsally with a lilac dorsal stripe posteriorly, the subdorsal and lateral areas dark purple brown with a white sublateral spot. 8th somite with a heart-shaped yellow dorsal mark, two white subdorsal specks and a white sublateral dot. 8th to 12th somites with a broad chestnut dorsal stripe, the lateral area lilac. Venter dark chestnut on 1st to 4th somites and dark olive brown thereafter, a blackish median line on the 1st to 8th somites and white on 9th somite backwards. Legs black. Prolegs lilac. Resting attitude with the head thrown back, the 3rd pair of legs extended and the others folded flat, the body slightly humped.

Pupa in a spun up leaf. Very dark olive brown, almost black, the wing cases and intersegmental areas paler. Cremaster a bunch of hooked spines.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 9-vi-44, spun 10-vi-44 and a male emerged 27-vi-44.

Boarmia acaciaria Bsd.

Moore, *Lep. Ceyl.*, iii, 415, pl. 191, fig. 1b. 1884-87.
Hamps., *Fauna Brit. Ind.*, Moths, iii, 265. 1895.

Head buff, speckled with darker, rounded. Body leaf green, the intersegmental areas yellow-brown. 5th somite with a red brown subdorsal tubercle and a square dorsal spot edged with whitish on each side. 6th to 10th somites each with a subdorsal white dot anteriorly. 11th somite with a double white dorsal tubercle. Legs pinkish. Prolegs green. Venter green with median white speckling. Spiracles purple with a white centre.

Pupa subterranean in an earthen cocoon. Olive green tinged, except on the wing cases, with orange. 2nd abdominal somite with a subdorsal orange red blotch, 5th with a lateral black blotch. Cremaster a stout spine, bifid from about the middle.

Food-plant—Rose and Garden Pansy. Moore gives *Cinnamomea*, etc.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 20-v-44, buried 24-v-44 and a male emerged 12-vi-44.

Moore's description is 'Larva with 10 legs; green; with two purple-brown biconical dorsal prominences on sixth segment and two dorsal white spots on twelfth segment; head and legs pale purple-red; anterior and anal segments in male laterally black speckled, spiracles black ringed. Pupa red, greenish in front.' Hampson's description appears to have been based on that of Moore.

Medasina albidaria Wlk.

Head triangular, slightly bifid above, dark brown mottled with paler. Body dark olive brown, the lateral area of the 2nd to 4th somites greener. 4th somite with a buff, heart-shaped, dorsal mark. 5th somite expanded into a subdorsal tubercle and with a greenish-buff triangular mark dorsally, the mark containing two minute dorsal tubercles. 8th somite with a greenish-buff, heart-shaped dorsal mark. 11th somite with a transverse, raised, greenish-buff band. 8th to 11th somites marked with greenish-buff laterally. Spiracles red brown ringed with buff. Venter with the thoracic somites dark brown, 4th and 5th paler with dark mottling, 6th somite with a minute double tubercle centrally, 6th to 9th somites dark brown with an obscure paler median stripe, 10th and 11th somites whitish with a dark median line. Legs brown.

Pupa subterranean without any visible cocoon. Thorax and wing cases very dark olive brown, the abdomen chestnut with the intersegmental areas darker. Cremaster a stout spine, bifid at the tip.

Food-plant—Cherry, Rose.

Described from a full fed larva found at Tukdah (5,000 ft. Darjeeling District) 10-v-44, buried 12-v-44 and a female emerged 5-vi-44.

(*To be continued.*)

A BIRD PHOTOGRAPHER IN KASHMIR.

BY

W. T. LOKE.

(*With four plates.*)

Photographing birds in Kashmir has great advantages; the weather is cool (at least in the earlier part of the summer) and the native inhabitants have quickly come to realise that mad people who pursue birds have their economic potentialities. This latter is not an unmixed blessing. The advantage is that there is a small body of shikaris who cater (for a sum) for the needs of the ornithologist and are pretty good at their work; the rub comes because of the grasp-all, beg-for-everything policy of these same gentlemen. You hire a man for, say, Rs. 50 a month (I speak of wartime prices) only to discover within a day or two that he finds it impossible to work without the help of his cousin who promptly demands a preposterous wage. During the course of any operations you will also discover various hangers-on in the shape of small boys and other ragged men who are always said to have rendered service of one sort or another and, of course, have to be paid. Finally, you are constantly reminded by your own men that their clothes are wearing out, their *chaplis* coming to pieces and that surely there must be unwanted (but to them welcome) crumbs falling daily from the master's table. Moreover, all Kashmiris are of the unshakeable opinion that the middle name of any 'sahib' must be 'baksheesh'. You will, at first, be inclined to lose your temper with all this, but will mind less when you find that the rogues are nevertheless pleasant, humourful rogues. Any out-of-ordinary attempt at extortion can always be checked in the most miraculous way by an offer, in the cause of justice, to place the matter before the Visitors' Bureau.

I began operations in the third week of April of this year (1944) which was perhaps a little early for birds' nests, although there were certainly plenty of signs of nuptial activity. Kites (*Milvus migrans lineatus*) were, of course, well advanced in their breeding activities. Numbers of Chenar trees contained their huge, rag-decorated nests of agglomerated twigs. Sparrows often took advantage of the lower storeys of these structures in which apparently to place their own nests, for I have seen as many as a dozen birds collected there, some of whom appeared to be incubating eggs. Kites (both *Milvus m. govinda* and *lineatus*) seem indeed to be very tolerant towards the presence of other birds about their nests: I have seen a mynah displaying within a foot or so of a sitting kite on a palm tree in Bombay, and in Kashmir I once saw a hen-sparrow jump perkily on to the rim of a kite's nest and disturbing the owner's long tail—the kite obligingly moved its tail away! Against its own kind, however, the Kashmir bird would appear to keep a considerable area of territory. In the whole of the Shalamar Gardens, for instance, I saw but one new nest of a kite, although the gardens contain many fine, desirably-tall Chenar trees. Of the more common birds actively preparing for the breeding season among others, I noticed:—Starling, White-eared Bulbul, Hoopoe, Pied Kingfisher, Indian Grey Tit, Jackdaw, Oriole, Pied Wagtail, Jerdon's Little Ring-Plover, Red-wattled Lapwing, European Swallow. The list should include many more but the ones above are mentioned because I took, or tried to take, photographs of most of them during the last days of April. The Swallows (*Hirundo r. rustica*) need a little more mention because of their engaging, 'domesticated' habits. Their yearly nesting on the low ceiling of the Srinagar post-office is already well-known: the comings and goings of the clerks who work below them do not bother the birds in the least. It is also usual for them to select the prow of a houseboat for a building-site, and I myself saw a pair roosting nightly in the 'sitting-room' of a small, two-roomed houseboat among the beams of which they eventually built their nest. The birds took little notice of the human occupants of the sitting-room and could easily have been touched with the hand as they sat closely together on a loop of electric cord!

The chief problem for the bird-photographer in wartime Kashmir is the difficulty of transport. Motor-taxi fares are prohibitive and so recourse must be had to the bicycle, tonga and shikara[1], all of which are distinguished by varying degrees of slowness. The bicycle is perhaps the best and most convenient vehicle. I have cycled 20 to 30 miles a day loaded down with a heavy 6 cm. × 9 cm. Graflex camera, but it needs almost fanatical enthusiasm to achieve this! Consequently it is well to live as near one's area of operations as possible. For this purpose Ganderbal—a village at the north end of Anchar Lake—must be one of the best situated. From here Anchar Lake may be reached by shikara with reasonable ease, Woyil Bridge is not too far away, and the lower reaches of the Sind River and the marshes of Ganderbal close at hand. Anchar Lake is a paradise for the ornithologist. It is especially rich in water and marsh birds: Pheasant-tailed Jacana, Turkestan Rail, Dabchick, Ruddy Crake, Eastern Baillon's Crake, Painted Snipe, Paddy Bird, etc., all breed here. The lower reaches of the Sind River and its branch channels will provide many of the tree-nesting birds: Golden Oriole, Tickell's Thrush, Rufous-backed Shrike, Paradise Flycatcher, doves and others. Woyil Bridge and the environs of Ganderbal will give you many of the birds of mountain-stream and open hills: Jerdon's Little Ring Plover, Red-wattled Lapwing, Chukor, Sandpiper, Plumbeous Redstart, Meadow and White-capped Buntings, European Bee-eater, White-capped Redstart, Stonechat, etc.

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[1] 'Shikara' must not be confused with 'shikari'. The latter is a hunter; the former Kashmir's version of the gondola, always advertised as having 'best spring seats'.

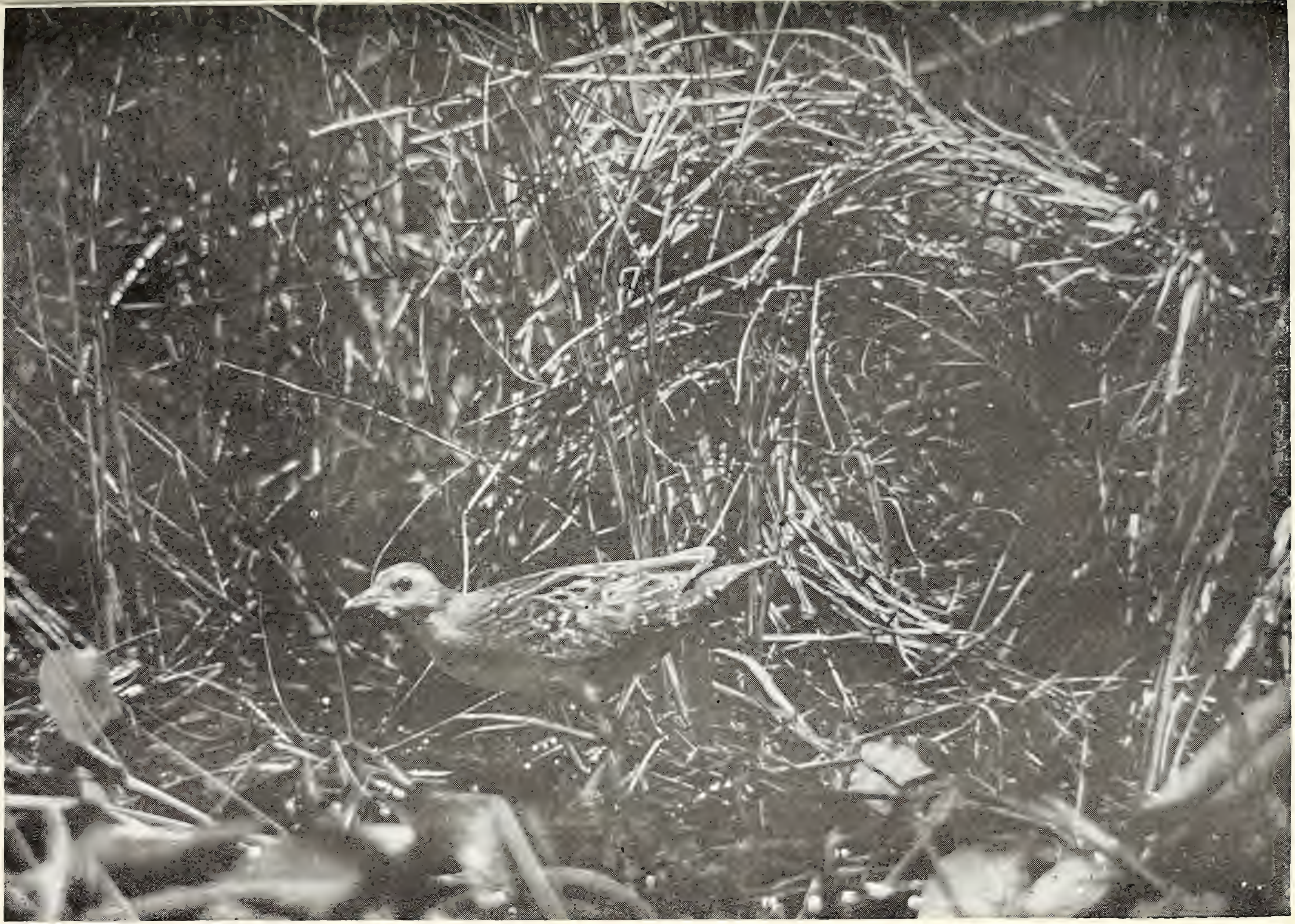

Photo by. *W. T. Loke.*

Eastern Baillon's Crake (*Porzana pusilla*).

This shy denizen of the marshes of the Vale of Kashmir was photographed only after repeated efforts.

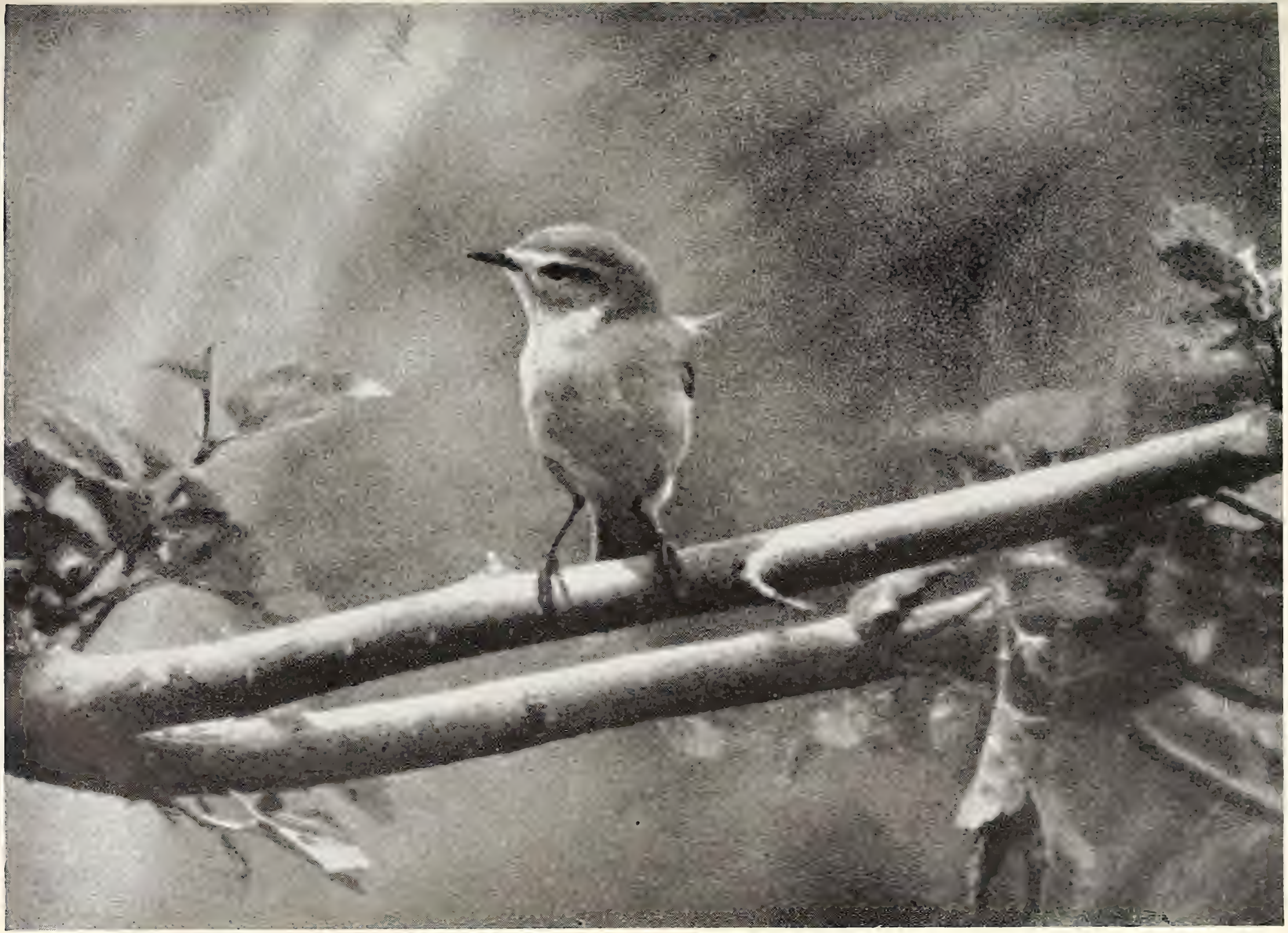

Photo by W. T. Loke.

Willow-Warbler.

I moved out to Ganderbal in a small houseboat in the second week of May and spent three busy weeks there, going to work by shikara, bicycle or on foot. In Ganderbal the houseboats are anchored on the snow-waters of the Sind River so that the temperature here, at any given time, is far lower than in Srinagar. My three weeks at Ganderbal and the preceding three weeks in Srinagar were days enlivened by a number of adventures. Walking about a Kashmir marsh, for instance, I can perhaps best liken to walking on the surface of one of those 'Lilos' or rubber-mattresses beloved of sun-basking, peacetime swimmers, with the further addition that the rubber is decaying and oneself in constant danger of falling through to the murky waters below! There are also patches of muddy ooze set in the midst of these marshes and if you are unlucky enough to strike a really soft patch (as I was) you will find yourself up to the hips in sucking mud before you know where you are. Sitting in the hide, balancing one's stool on a narrow board held under water by one's weight and with one's legs immersed for hours almost up to the knees in water is another of the prices to be paid for pictures of marsh bird celebrities. The Painted Snipe, indeed, kept me waiting five days for his! On the reed-fringed margin of Anchar Lake I had my most interesting and exciting experience so far as a bird photographer. While waiting for the return of a dabchick to its nest, I had the supremely good fortune to see a young bird breaking out from its shell, and later being transported to safety on the back of its agitated parent. Another experience—this time near Woyil Bridge—was having a 2 lb. headless fish dropped on me by an osprey which had alighted unsuspectingly on the top rim of my circular hide. I must, however, own to a certain dissatisfaction because the fish turned out to be only a 'churoo' and not a trout!

A piece of carelessness on the part of one of my shikaris earned him the name of 'the cuckoo'. We had found a nest of the Golden Oriole attached to a slim branch of *Robinia pseudoacacia* and had pulled it down to remove a small twig which came directly between the nest and the camera. Whilst doing this, the shikari allowed the branch to slip from his hand with the result that all the eggs were catapulted into the air. Quite unperturbed by this accident the shikari disappeared into the jungle and soon returned with another three Oriole's eggs which he had stolen from another nest and these he placed into the excellently situated nest I was trying to photograph. The Orioles never noticed the substitution and I had the pleasure of coming back to the same nest some days later to photograph the unsuspecting foster-parents feeding the young birds.

When the weather became warmer, I moved up to Sonemarg (about 9,000 feet) which guards the entrance to the valley leading to Baltal and the Zoji-la Pass. Here I lived in a tent for five weeks and spent the happiest time of all. In Sonemarg one lives in a field surrounded by mountains, woods and streams and in the midst of breeding birds. Meadow Buntings are exceptionally common and their nests to be found with no difficulty. Choughs (both red-billed and yellow-billed), Snow Pigeon, Dipper, Grey Wagtail, Sandpiper, Goldfinch, Greenfinch, Rosefinch, Hodgson's Pipit, Grey-headed Thrush, Blue-headed Rock-thrush, Kashmir Wren, various Warblers (the Large-crowned Willow-wren being most common), Stonechat, Hodgson's Shortwing and a host of others live and breed all round you.

In the thick and dark woods of Sonemarg I had an opportunity of trying out photography by means of sunlight reflected from a mirror—flash bulbs being, of course, unobtainable in war time. Results were mostly poor due to films of very slow speed but the reproduction in this article of a picture of a Grey-headed Thrush taken by this method shows what can be done with a not too shy bird and fast film. The woods swarm with various species of *Phylloscopus* which usually place their nests in ill-lit places; they are by no means shy birds and to their photographing the mirror technique might well be tried with success.

Mention of photographic technique leads me to a discussion on photographic methods. I am convinced that no one method will, by itself, be completely satisfactory. The usual way of photographing from a hide still seems to me to be the best although the use of a distant release should also produce good results in many cases. Certainly Col. Phillips of Srinagar, who I believe uses this method exclusively, has some fine pictures to his credit. Flashlight, both the ordinary press-type and the new spotlight, should be extremely useful on occasion. Problems calling for a flashlight may often be met by the use of a mirror; it is a method with the advantage that it is cheap and probably less likely to frighten the bird. Up till recently a confirmed miniaturist, I have found a 35 mm. camera in India entirely unsatisfactory for bird photography. Grain-free prints at high magnifications seem almost impossible to achieve and enlargements nearly always suffer from loss of definition. This applies to films processed in Kashmir as well as (or even more so) to those processed in the plains. True, I have been unable to do my own processing due to inability to buy fine grain chemicals but it still seems to me that where you have such a small image to deal with as, for example that of a Sooty Flycatcher, your bigger negative is bound to score. It is certain that I have not regretted selling my miniature and replacing it with an old fashioned type of reflex-camera using size 6 cm. × 9 cm. (2¼ ins. × 3¼ ins.) film—the Graflex. With the latter camera I am entirely satisfied. The shutter, or rather the mirror release and shutter mechanisms together, is no doubt excessively noisy but it is surprising how soon a bird can get used to noise. Besides, in photographing an incubating bird it is no disadvantage to have it off the eggs every now and again. In spite of my noisy shutter, I still have, on occasion, to employ my shikari to drive the bird off its nest. All my pictures from Kashmir were taken from hides. Of these I have two; one I call my ring hide which was designed by Mr. Sálim Ali, the other

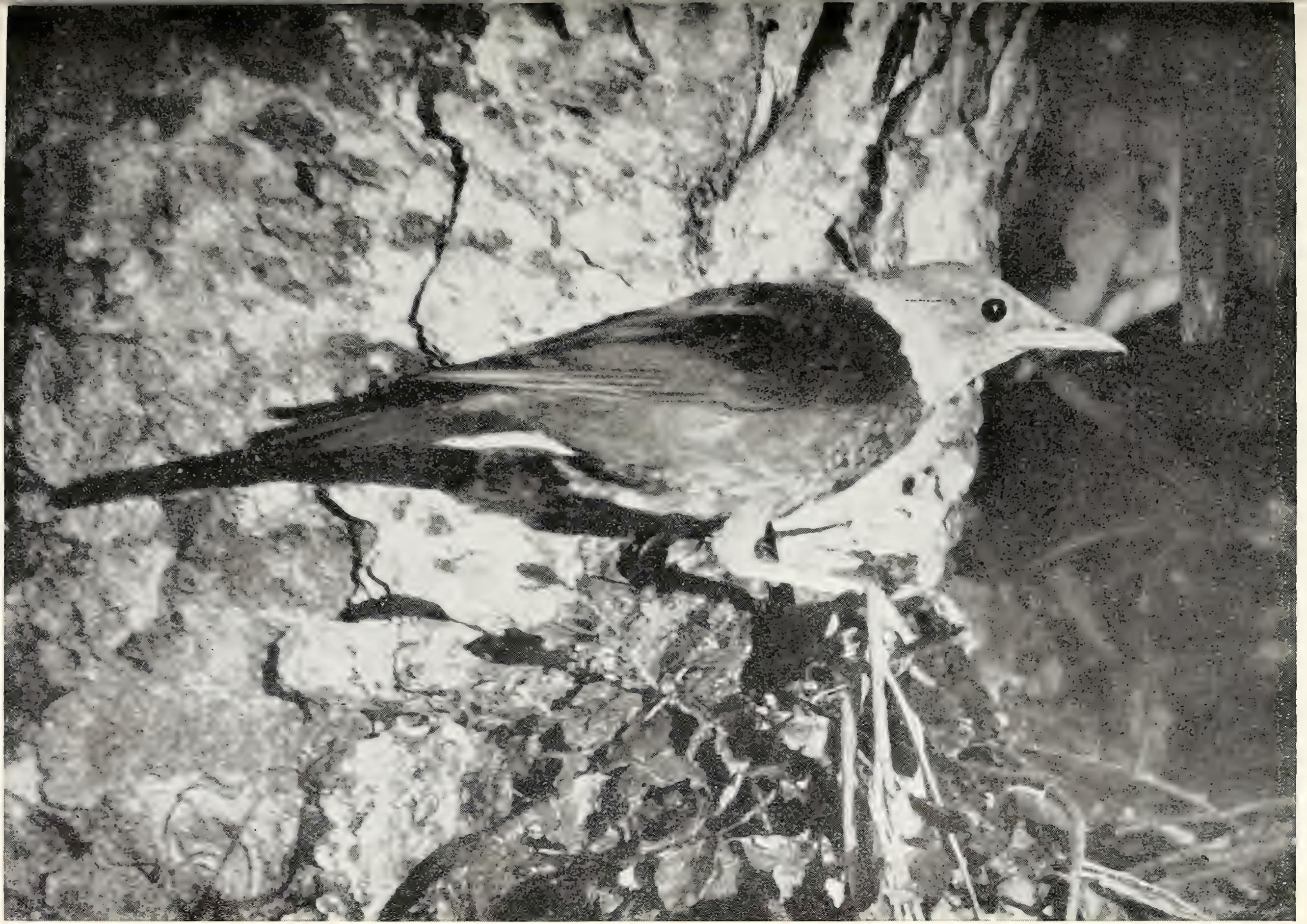

Photo by *W. T. Loke.*

Grey-headed Thrush.

This photograph illustrates the use of a mirror for lighting up nests placed in ill-lit situations. (See text.)

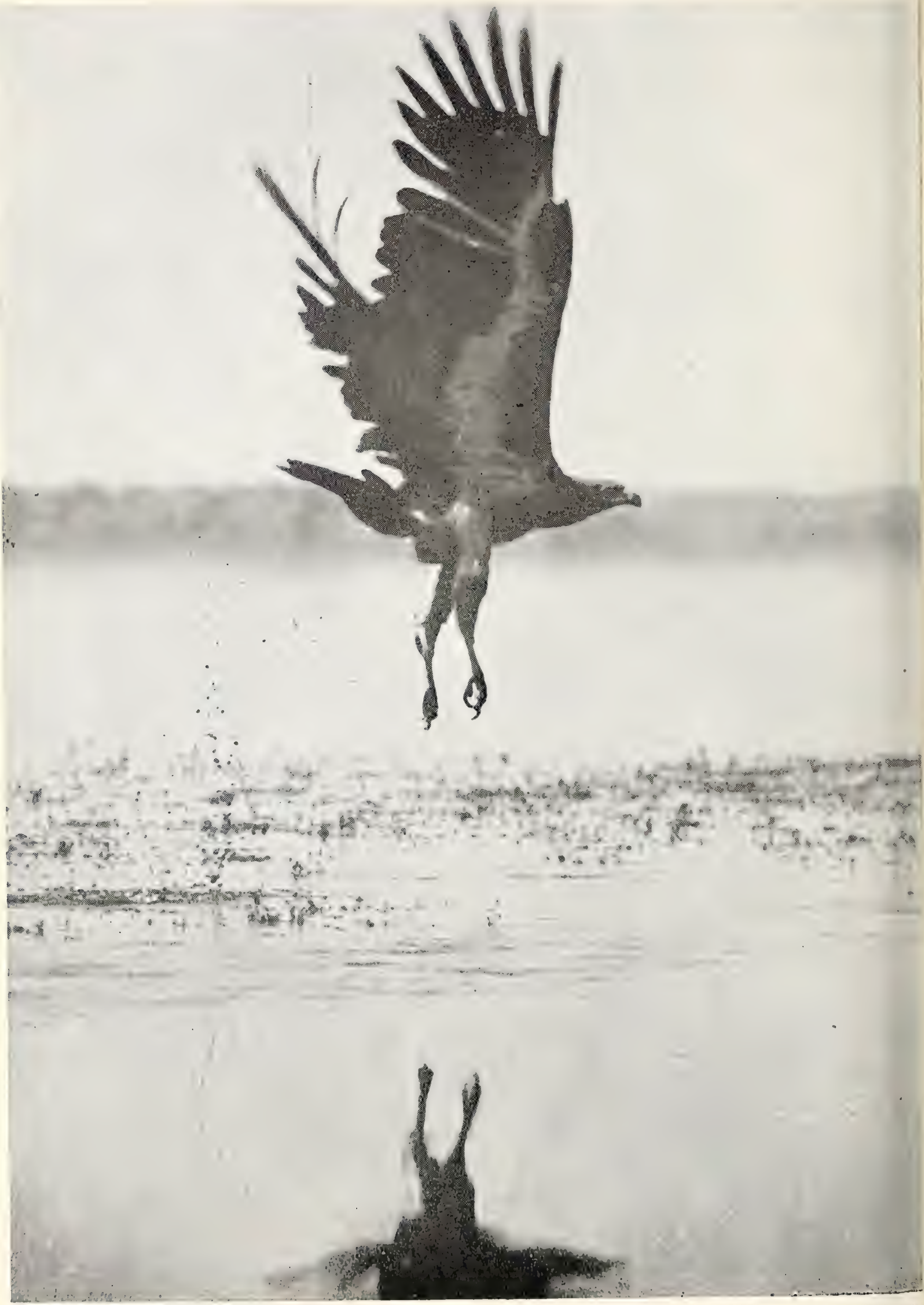

Photo by *W. T. Lok*

Pallas's Fishing Eagle (*Haliaëtus leucoryphus*).

These birds are common about the lower reaches of the Jhelum River, near Wular Lake, where this picture was taken.

an ordinary shaped oblong tent 4 feet long, 3 feet wide and 4 feet high. The former consists of two circular metal rings with a thin material stretched between them and is of ample dimensions making it eminently suitable for use under hot desert conditions. The top ring is supported on three metal rods driven into the ground; the bottom ring hangs loose and serves to keep taut the cylinder-like body of the hide. The ring hide is useless in a high wind. The tent hide is nothing more than a small tent attached to the ground by means of guy ropes and pegs. It is made of heavier material than the ring hide and consequently flaps less in a strong wind. I found it very useful in Kashmir. Both hides have been camouflaged with green and brown paint with the hopes of making them look more a part of the landscape: the measure of success achieved I should perhaps refer to the lady who one day, when the hide was erected beside a nest of *Hodgsonius phoenicuroides,* came up to within 30 feet of it, looked carefully round to see that no one was near and . . . . is still to this day perfectly satisfied that no one was.

The two shikaris working for me were good at their work and understood my requirements well. It was, however, difficult to impress upon them the undesirability of flat lighting and that to have the sun shining from behind you directly upon the subject will not help to make a good picture. They also have a favourite trick of tying captured young birds which have just left the nest to a stick in the ground by means of a length of string. You are taken next morning to photograph the parents coming back to feed their young, but you will usually find that the wretched little thing has broken its legs in its frantic attempts to get free. Needless to add, you should whenever possible prevent the shikaris from doing this.

With wonderfully cool weather, the help of trained shikaris, ideal temperatures for fine grain film development, working among magnificent scenery and a multitude of breeding birds, one can hardly fail to get good bird pictures in Kashmir. In the course of eleven weeks I photographed the species contained in the following list, with varying degrees of success, and cannot say that I have any reason to be dissatisfied. True, films (especially fresh stock) are difficult to obtain in wartime, but given peacetime conditions one would have to be a very bad photographer to have more than a small percentage of failures.

LIST OF SPECIES PHOTOGRAPHED

SPECIES	DATE	PLACE	REMARKS
Indian Grey Tit (*Parus major caschmirensis*) ...	25-4-1944	Anchar Lake	Nest under construction
Crested Black Tit (*Lophophanes melanophus*) ...	7-6-1944	Sonemarg	Young
White-eared Bulbul (*Molpastes leucogenys leucotis*) ...	29-5-1944	Ganderbal environs	Young, almost ready to fly
Hodgson's Shortwing (*Hodgsonius p. phoenicuroides*) ...	11-7-1944	Sonemarg	Young, newly hatched
Stonechat (*Saxicola torquata indica*) ...	16-6-1944 17-6-1944	Sonemarg	Young in one nest; eggs in the other
Spotted Forktail (*Enicurus m. maculatus*) ...	21-5-1944	Ganderbal	Young, newly hatched
White-capped Redstart (*Chaimarrhornis leucocephala*) ...	10-7-1944	Sonemarg	Young
Plumbeous Redstart (*Rhyacornis f. fuliginosa*) ...	1-5-1944	Woyil Bridge	Young, newly hatched
Tickell's Thrush (*Turdus unicolor*) ...	19-5-1944	Ganderbal environs	Eggs
Himalayan Whistling Thrush (*Myophonus caeruleus temminckii*) ...	14-6-1944	Sonemarg	Young in down
Paradise Flycatcher (*Tchitrea paradisi leucogaster*) ...	1-6-1944	Anchar Lake	Eggs
Kashmir Sooty Flycatcher (*Hemichelidon sibirica gulmergi*) ...	23-6-1944	Sonemarg	Eggs
Rufous-Backed Shrike (*Lanius schach erythronotus*) ...	23-5-1944	Ganderbal environs	Eggs
Indian Great Reed-Warbler (*Acrocephalus stentoreus brunnescens*) ...	29-5-1944	Ganderbal environs	Eggs
Large Crowned Willow-Wren (*Phylloscopus occipitalis*) ...	3-7-1944	Baltal	Young, ready to leave nest
Phylloscopus ...	25-4-1944	Anchar Lake	Photographed near nest of *Parus major*
Phylloscopus ...	18-6-1944	Sonemarg	Young
Golden Oriole (*Oriolus o. kundoo*) ...	29-5-1944	Ganderbal environs	Eggs
Meadow-Bunting (*Embriza cia stracheyri*) ...	13-6-1944	Sonemarg	Young, newly hatched
European Swallow (*Hirundo r. rustica*) ...	28-4-1944	Nagin Lake	
Hodgson's Pied Wagtail (*Motacilla a. alboides*) ...	5-3-1944	Woyil Bridge	Eggs
Grey Wagtail (*Motacilla cinerea melanope*) ...	3-5-1944	Woyil Bridge	Eggs
Little Skylark (*Alauda gulgula lhamarum*) ...	10-6-1944	Sonemarg	Eggs
Himalayan Pied Kingfisher (*Ceryle lugubris guttulata*) ...	25-4-1944	Anchar Lake	Uncertain
Central Asian Kingfisher (*Alcedo atthis pallasii*) ...	6-6-1944	Nagin Lake	
Eastern Baillon's Crake (*Porzana p. pusilla*) ...	27-5-1944	Anchar Lake	At nest
Ruddy Crake (*Amaurornis fuscus bakeri*) ...	18-5-1944	Anchar Lake	At nest
Red-wattled Lapwing (*Lobivanellus indicus aigneri*) ...	5-5-1944	Woyil Bridge	At nest
Jerdon's Little Ring-Plover (*Charadrius dubius jerdoni*) ...	22-4-1944	Ganderbal	At nest
Common Sandpiper (*Tringa hypoleucus*) ...	1-5-1944	Woyil Bridge	At nest
Painted Snipe (*Rostratula benghalensis*) ...	18-5-1944	Anchar Lake	At nest
Paddy Bird (*Ardeola grayi*) ...	1-6-1944	Anchar Lake	Eggs
Little Bittern (*Ixobrychus minuta minuta*) ...	2-6-1944	Anchar Lake	Eggs
Little Grebe (*Podiceps ruficollis capensis*) ...	2-6-1944	Anchar Lake	Eggs

DESTRUCTIVE METHODS OF FISHING IN THE RIVERS OF THE HILL RANGES OF TRAVANCORE.

BY

S. JONES, M.SC.

> *"Lo! a child is born in the fisherman's house!*
> *Lo! the newly born fellow carries a net on his head!*
> *Dhar, dhar, weeps the Singni fish, my love!*
> *My life-long enemy is born today!*
> *Alas, alas, O alas!*
> *My life-long enemy is born today!"*
>
> (The Gond's song of the Singni fish by Devendra Satyarthi)

INTRODUCTION

Much has been said since the middle of the last century deprecating the destructive methods of fishing in the freshwater tracts of India. Exposed as Travancore is to both the monsoons, the rivers of the State contain water throughout the year, though they are small and most of them little larger than torrential streams compared to large rivers on the East Coast and of North India. In these rivers, which once contained an abundance of fish, it is hardly possible now to see a good sized specimen in the low-country due to over-fishing and the same is true of the mid-country or the semi-hilly tracts. The up-country consisting of the mountainous districts withstood the encroachment of Man for some time, but since the opening up of a fairly extensive area for plantations, such as tea, rubber and cardamom, there is hardly any area in the State which is not within easy access of Man. Before this the original inhabitants of the jungles, like the hill men of the *Mannan, Paliyan, Oorali, Muthuvan* and *Kanikkar* tribes, used to live close to the rivers and streams and fishing also had been one of their vocations in life for their daily sustenance. In those ancient days there was none to dispute their right in the extensive 'jungle areas with plenty of wild game and forest produce'. Since large scale clearing of jungles began they have been pushed back to the least fertile of the tracts, their movements have been restricted, the wild game has been reduced considerably and the needs of life have increased. This state of absolute poverty together with their inherent laziness compels them to resort to every means, foul or fair, in their struggle for existence. The net result of all these in their fishing vocation is the extensive use of poisons wherever and whenever possible for capturing fish. According to the story narrated by the head of a *Mannan* colony near the Tual waterfall in Vandanmettu-Kallar River in Peermade, it was one of their forefathers, a king of the jungles, hundreds or thousands of years ago that introduced the fish from the lower side of the waterfall to the upper side; and therefore as protectors of the fish they are not allowed by ancient tradition to capture it by poisoning. But all such scruples have yielded to the insistent demands of life nowadays and poisoning of fish for easy capture has become one of their routine activities during the hot months.

The southern region of the Western Ghats consists of the mountainous tracts of Travancore which cover nearly half the State's total area of 7,625 sq. miles. From north to south the hill range is nearly 200 miles long and several rivers arise from here and flow towards the west into the Arabian Sea. The northern region is more extensive, its elevation is greater and the rainfall is heavier, and for these reasons all the large rivers are confined to this area. There are two artificial lakes in the mountains, the Periyar Lake in the north and the Kothayar Lake in the south.

Types of Fish available in the Streams and Rivers of the Hill Ranges of Travancore.

The study of the fish fauna in this region is far from complete. Only very recently some new and interesting species such as *Travancoria jonesi* Hora (1941), *Lepidopygopsis typus* Raj (1941), *Batasio travancoria* Hora & Law (1941), *Barbus (Puntius) ophicephalus* Raj (1941 a) and *Barbus (puntius) micropogon* subsp. *periyarensis* Raj (1941 a) have been added to the list and the distribution of several others has been extended to Travancore (Hora & Law, 1941 & 1941 a and Hora & Nair, 1941). For a complete list of the fresh water fish of Travancore including those represented in the hill ranges, the works of Pillay (1929), John (1936) and Hora & Law (1941 a) may be consulted in addition to the references mentioned above. Mention may also be made of an exotic fish, the Rainbow Trout[1], that has become acclimatised in the rivers of the Kannan Devan Hills (Gopinath, 1942).

Among the hill stream fishes in Travancore, the greatest favourite and one of the most delicious is the local Mahseer, *Barbus (Tor) khudree* known as *Kuyil* in Tamil. The larger among the rest, like *Rasbora daniconius*, *Barilius gatensis*, *Danio aequipinnatus*, *Garra mullya*, etc. are eaten by the middle class people when fish is scarce. The coolies and hill men eat any fish they get without much discrimination.

Dr. Hora has given a comprehensive account of *B. khudree* in his game fish series in the Journal of the Bombay Natural History Society (Hora, 1942). This is perhaps the largest fish in the hill streams and rivers in Travancore and according to Hora it is the commonest species of these parts and its range extends along the Satpura trend to the Central Provinces (Hora & Law, 1941 a). I have seen fish up to 22 inches in length caught from Vandanmettu-Kallar River and I am informed that fish up to three feet are not uncommon. I have known from very reliable sources that fish weighing about 30 lb. have been taken from the river about 12 years ago. Unfortunately since the use of dynamite for easy fishing in hilly tracts has become very common large Mahseers are extremely rare. In this respect perhaps the Vandanmettu-Kallar and the tributaries of the Periyar south of Kumili are some of the few rivers that have not been greatly affected so far. Though fishing is prohibited in almost all the rivers and streams in the hills, it would be better if such of those rivers as still remain safe and important breeding grounds for the Mahseer are rigorously protected by special legislation and by the appointment of additional watchmen during the summer months. Along with this it is necessary that the proper kind of fishing like angling should be encouraged.

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[1] The wandering instincts of the Ceylon and Travancore Trout and its vertebral and scale counts show that it is not a true Rainbow but a hybrid between a Rainbow and a Steelhead. For details see Philip Fowke, *Cey. Journ. Sci.*, v, 1938; pp. 1-78 & Mackay, W.S.S., *J.,B.N.H.S.*, xlv, 1945; pp. 352-373 & 542-557.

B. khudree is a clever fish and successful catches can be made with only proper baits. It is the elusive nature of the fish that obliges the local people to abandon the proper methods and resort to other more sure but destructive methods of catching it. It is necessary that the habits of the fish should be studied thoroughly to achieve the maximum success with the rod and line and a more sporting tendency should be developed among the people. In the Periyar Lake and within the Peermade Game Reserve, *B. khudree* is caught with rod and line. Both in the lake and in its head waters fish up to 20 lb are generally caught with spoon or plug bait and on fly. The Annual Reports of the Peermade Game Association may be referred to for further details.

A closed season should be fixed for this fish after a careful study of its breeding habits (Jones, 1946). The capture of fish during migration for breeding (Jones, 1941) should also be stopped. The general practice of setting fire to the grasslands is to be strongly deprecated as this not only destroys to some extent the insect life close to the banks but also contributes to the filling up of the pools in the course of the stream with silt and mud due to soil erosion. There is no doubt that with more rigorous legislation and mass education the destructive tendencies would be considerably eliminated. In certain pools close to the temples, as at Ayyappancoil and Vandiperiyar in the course of the Periyar River, large sized specimens of *B. khudree* are much less shy of man; they come close to the edge of the water and feed on the offerings given.

Destructive Methods of Fishing.

While dealing with the freshwater fish and fisheries of Travancore, John (1936) described some of the destructive methods of fishing, especially those employed in the plains. Some of the methods followed in the up-country, such as the use of copper sulphate, jatropha seeds, fixed engines and tripod net were also noted by him.

The methods of fishing in different parts of South India are similar in principle with some modifications according to the local conditions and ingenuities of the people. The employment of such 'exotic' materials as dynamites and chemical poisons would depend on their availability. Thomas (1870) in his report on pisciculture in South Canara and Wilson (1907) in his reports on the methods of capture and supply of fish in the rivers of Nilgiri District list the destructive methods of fishing practised in those tracts.

Thomas (1870) refers to the poisoning of fish in the rivers with *Croton tiglium, Anamirta cocculus, Capsicum frutescens* and a species of *Posoqueria* known as 'Káre Kai' in Tulu. He is also of opinion that the residue from the coffee pulpers erected in the course of rivers may have a detrimental effect on the fish-fauna of the locality. Among the fixed engines different kinds of basket traps placed in small channels and in the middle of artificial dams and obstructions constructed across the river for the capture of fish going up as well as coming down the river are mentioned. He suggests that watchmen should be appointed to prevent poisoning and construction of fish wiers. The basket traps should according to him have wide spaces to allow all under sized fish to escape. He is against advocating a closed season since he is of opinion that in many fishes breeding period is very extended and in the case of those spawning at the commencement of the monsoon rains due to the floods prevalent then a natural closed season is imposed.

Wilson (1907) speaks of the fishing in Bhavani, Moyar and in some small streams near Ootacamund. Here the chief methods are the use of fixed engines consisting of basket traps, some of them so small meshed as to be known as fry traps, poisoning with berries and dynamiting. He refers to the use of cradle trap which is a modified basket trap in some parts of the Moyar River when the level of water is not very low. His main suggestions for the improvement of the fisheries are appointment of watchmen to prevent dynamiting, poisoning and other illegal methods of catching fish, legislatoin against the use of fixed engine, regulation of the mesh of cast nets and introduction of new varieties of fish into suitable streams.

The list of destructive methods for the hill ranges of Travancore given in this article is by no means complete. It has been mainly compiled from the information received and as a result of enquiry made during the writer's stay in the Cardamom Hills. In some of these up-country regions, settlers from other parts have introduced their own methods of fishing, so that a clear demarcation of the methods peculiar to different regions is hardly possible. Destructive methods of fishing in the hilly tracts of Travancore come under the following main categories, viz. use of explosives, poisons (chemical and vegetable), traps and nets.

EXPLOSIVES.

Dynamite (*Thotta*, M. & T.[1]) : This is perhaps the most fashionable and at the same time one of the most destructive of all methods employed for catching fish in the hills. Due to the opening up of several roads, dynamite, which is necessary for blasting stones has become easily available though some difficulty is experienced now due to the war. To have the maximum effect in the use of a dynamite the bed of the pool should be rocky or sandy and the time adjustment of the explosion should be such that it would take place at the correct depth. The fish come up due to the shock and those that die sink down immediately. The destruction is so thorough that hardly any fish, large or small, within a radius of about 5 to 10 yards survives. Those at a distance are partially affected and remain in a dazed condition facilitating easy capture. The small sized fish is ignored and the larger ones, which form only a fraction of the total kill, are caught by people who jump into the water immediately after the explosion with their bodies rubbed with oil and ears plugged with cotton wool, if the water is very cold. In large pools where a good catch is expected sometimes two dynamites are used simultaneously to produce double effect!

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[1] M = Malayalam. T = Tamil.

Crude explosives (*Kettu-thotta,* M. & T.):—Country made explosives are made in old types of soda water bottles and in unopened cocoanut shells. In the case of the former type the explosion is said to be tremendous and the destructive power very great.

POISONS.

Copper sulphate (*Thurisu,* M. & T.):—This stuff as one of the components for the preparation of the Bordeaux mixture, commonly used for spraying diseased plants, is available in the estates and the employees who have access to it during the spraying season save small quantities of it without the knowledge of the estate authorities. Usually a suitable pool in a stream, where a good number of fish are suspected to be present, is selected and heavy flow of water if any, is diverted and powdered copper sulphate is put in a cloth and is dissolved at the head end. The gentle flow of water diffuses the copper sulphate and the fish come up to the surface of the water in a stupified and lethargic state when they are caught. Both large and small sized fish, including the Mahseer, are affected and it may not be unusual to see small dead fish flowing along the course of the stream. This method and the one described below are employed extensively in the rubber plantations.

Bordeaux mixture (*Bodo-marunnu,* M. & *Bodo-marunthu,* T.):—At the time of spraying of the rubber trees the hose is directed to a pool if there are any streams nearby and any fish that comes up is then caught. This is usually done by the Conductor or Kangany who is in charge of the spraying operations. Any excess of the mixture that becomes available after a day's spraying is sometimes utilised for the purpose of catching fish.

Lime (*Kummayam,* M. & T.):—Large quantities of unslaked lime, if stirred in pools, would force the fish to come up in a dazed condition, when they are caught. This method is not employed extensively in the interior because large quantities of the stuff are not easily available due to the heavy cost of transport.

Cyanogas or *Calcium cyanide* (*Plague marunthu,* T.):—I am informed from very reliable sources of instances of fishing by the employment of this deadly poison by people who have had access to this fumigant[1]. Though this method is gradually becoming popular in certain areas in recent years it is practised at present only seldom due to difficulty in procuring the stuff. The poison is said to be very effective and a fairly large quantity of the fish is caught by stirring a small quantity of it in pools after diverting or damming the inflowing water. It is necessary that very rigorous action should be taken against those who commit this offence, all the more because it is the educated who are responsible for this.

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[1] This is usually available with persons in charge of antiplague measures.

Gelignite and dhal mixture :—The brown paste like gelatine dynamite is mixed with well ground dhal and is thrown in small pellets which are eagerly devoured by the fish. The action is instantaneous and the poisoned fish makes a few rapid spinning movements and sinks down dead. Only very little fishing is carried on in this manner since the gelignite could be more advantageously used as an explosive than as a poison!

Pā-eencha, M. (*Acacia pennata* Willd.) :—This is a large climber found abundantly in the hills and is known as *Kareencha* in South Travancore. The stem of this plant is cut into small pieces, crushed and thrown into the water which is then stirred. The action is fairly quick and all the fish both large and small come up senseless or dead. This is the commonest poison used by the hill-men throughout the State. Small streams and pools are best suited for the purpose. I recently saw a stream which was once full of small fishes of all types including the young of the Mahseer, without a vestige of fish-life a few days after the hill-men had conducted this utterly indefensible mode of fishing.

Mullakuru, M.; *Penkottei*, T. :—Seeds of the twiner, *Anamirta cocculus* W. & A. are crushed and ground well with dhal or rice and used with deadly effect for catching fish. This is said to be the most virulent of all plant poisons for fish. As they are not available in the interior of the jungles the method is usually employed by people at the foot of the High Ranges and in the semi-hilly tracts.

Nanchumaram, M. & T. (*Croton Kloteschianus* Thw.):—The leaves of this tree known as 'vakanathukozha' or 'roche' among the hill-men are crushed and used for catching fish in the pools in the course of streams. The crushed leaf is put in the water and stirred well and the fish that come up are caught by people who jump into the water for the purpose. The effect is said to be greater than that of *pā-eencha*. According to the custom of the hill-men, who mostly employ this method, those who go for fishing should avoid using tamarind in their food on the previous day and should spend the previous day and night away from their women folk in which case only they believe they would meet with success. Honey is also forbidden among some during this period. They do not permit other people, if they are suspected to be unclean, to touch the water they are fishing in.

Kutappanakuru, M.; Seeds of *Corypha umbraculifera* Linn. :—Unripe seeds of the sago palm or the talipot palm are crushed and stirred in the water for catching fish in the mid-country and on the western slopes of the hills. This method cannot however be employed continuously and extensively as this plant flowers only once in its life when it is usually cut down for the pith which is eaten.

Veli-avanakku or *Nanchanpathal*, M.; *Jatropha curcas* Linn. :—

Seeds of this hedge plant are crushed and stirred in pools and the fish that come up are caught. It is a very common plant in the plains from where the seeds are brought to the hills for the poisoning of fish.

Poothakarandavalli, M.; *Derris brevipes* Baker:—The tender leaves and flowers of this plant are used as fish poison. The plant is not quite common in the up-country and hence not very extensively used there.

Neervalam, M. & T.; *Croton tiglium* Linn.:—Seeds of this are ground well with dhal and earthworms and are thrown as small pellets into the water; and any fish that eats this would immediately come up. The fish caught in this manner is said to cause sometimes giddiness and vomiting when cooked and eaten.

Pencolum, M. & T.; *Sapium indicum* Willd.:—The seeds of this tree are crushed well and stirred in pools containing fish and all the fish that come up are caught. This stuff is usually brought by people from the low-country where it is available during certain seasons.

Thirukalli, M.; *Kalli*, T.; *Euphorbia tirukalli* Willd.:—In some of the hilly tracts of South Travancore this plant is crushed well and stirred in pools and small collections of water for catching fish. The milky sap of the plant is said to cause irritation to the eyes of the fish and make them partially blind.

TRAPS AND NETS.

Fixed engines; *Koodu*, M.:—This method is practically a monopoly of the hill tribes except in the lower side of the western slopes. Throughout the course of the streams it is not unusual to see low crude dams constructed with the help of stones, leaves and reeds from one bank to the other so that water would flow out only through the crevices. One or two places towards the middle are kept open where large basket traps are kept with their open ends facing the lower side of the streams so that all the fish including fairly large ones that ascend the streams and rivers are trapped. These traps are kept for long periods in one place, except during periods of heavy floods, and the trapped fish are collected regularly. The catches are heavy during the breeding season.

Cast nets; *Veechuvala*, M.:—These are brought by people of the lower regions owning estates in the hills and are not used extensively except in the Periyar Lake though it is strictly prohibited there also. The meshes of the nets are usually very small and therefore young fry and immature fish are also caught. These are said to be used with great effect during the breeding season when fishes migrate up the streams and rivers disregarding all obstacles. The nets are used to facilitate the capture of the fish that come up in a dazed condition after poisoning.

Tripod net; *Mukkalivala*, M.:—The contrivance used is figured and described by John (1936). In principle it is after the pattern of the Chinese prawn net. Three poles tied together at the top are erected in pools and a circular net is placed in the middle

Strong cords from the margin of the net are connected to a large central cord which is passed over the poles. Food is thrown in the net and a large number of the fish collect together without suspecting any foul play. The central cord is then suddenly pulled up and all the fish remaining within the net are caught.

Cloth and blanket collection :—The coolies and hill-men collect fish with the aid of clothes and blankets during the summer months. Small sized fish in small streams and pools are caught in this manner.

Chatty-pot collection:—A wide mouthed earthern pot is taken, some rice is put inside, the mouth is closed by a piece of old cloth with a hole in the middle of it and it is kept immersed in the water. After some time the vessel is gently lifted up, and all the fish found therein are collected. This is repeated a number of times till a sufficient quantity is caught. This method is employed occasionally by coolies and hill-men only who are thus able to catch small sized fish in this manner.

Hand collection:—During the summer months when the flow of water is very little, small streams are dammed at intervals and the water is baled out and all the fish present, both large and small, are caught.

Electric torches and lights:—This method is very common in the low-country but is also employed in the western slopes of the hills. It is comparatively not so destructive as the previous ones since only the large sized ones among those attracted to the light are killed.

Of the several methods of fishing in the hill ranges mentioned above the use of dynamites, copper sulphate, *mullakuru*, *nanchumaram* leaves, *Pā-eencha* and fixed engines are the most common and at the same time the most destructive. Dynamite and copper sulphate are mostly employed by people in the estate areas. *Mullakuru* is used in the semi-hilly tracts and in the western slopes of the hill ranges. It is necessary that the employment of the above three methods should be controlled by more rigorous legislation. *Pā-eencha*, *nanchumaram* leaves and fixed engines are employed usually by hill-men and these should be checked with the help of the Forest and Game Departments.

The destructive methods now employed in the hills affect the people resident there in more than one respect. Firstly the fish get so much reduced in number and size that rivers and streams become 'barren' and fishing will be hardly worthwhile in course of time. A rich and nutritious food is thus sure to run out of supply. In malarial tracts this is calculated to bring on serious consequences by devitalising the people and making them easily susceptible to the attack of malaria. To those with a sporting tendency, depletion of the larger fishes deprives them of an interesting game. Most of the small sized carps found in the hill-streams have been found to be efficient mosquito larvivores. During the hot months many of the small streams in cleared areas get converted into stagnant pools wherein mosquitoes breed freely and complete destruction of fish in such situations would tend to aggravate indirectly the malarial problem also.

ACKNOWLEDGEMENT

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'When thou wilt swim in that live bath,
Each fish, which every channel hath,
Most amorously to thee will swim,
Gladder to catch thee, than thou him'.

(By John Donne as quoted in 'The Complete Angler', 1653)

FIELD OBSERVATIONS ON THE *STERCULIAS* OF THE BOMBAY PRESIDENCY.

BY

CHARLES McCANN, F.L.S.

(*With a plate.*)

After a fairly intensive and critical field study of the various species included in the genus *Sterculia* as originally understood (by T. Cooke and others), I have come to the conclusion that there are a number of details in the existing descriptions that need correction, amendment, or explanation. I fully realize that many, if not all, of the original descriptions were based on herbarium specimens, and perhaps on imperfect material at that. On this account many of the characters were either overlooked or misinterpreted.

The genus *Sterculia* as understood by Cooke[1], and some of the older authors, has since been divided up. This division, in my opinion, is sound as some of the characteristic differences are well marked. Nevertheless, there are good characters which clearly show the close relationship between the genera and species. Blatter[2] indicated this division of the Bombay *Sterculias* and divided them up accordingly under the three genera: *Sterculia,* embracing *S. foetida, S. gutatta, S. urens,* and *S. villosa;* to these indigenous species he added *S. populnifolia* and *S. campanulata*: 2) *Pterygota,* is represented by a single species, *P. alata* (*S. alata*): 3) *Firmiana,* is also a monotypic genus in the Bombay Presidency, *F. colorata.* Blatter[3] followed Gamble[4] in transferring *S. colorata* to the genus *Firmiana.* The change was, however, occasioned by a confusion and accordingly the name *Firmiana* must be dropped. Mr. C. E. C. Fischer[5], though apparently not in favour of splitting up the genus *Sterculia* in its widest sense, pointed out that the generic name for *S. colorata* is strictly speaking *Erythropsis,* and accordingly it should be called *Erythropsis colorata* Burk. I favour such a change for reasons I shall indicate under the specific heading. Of all the species attributed to Bombay, I am not familiar with *S. populnifolia* and *S. campanulata,* and I have had no material at hand to work on in the field.

In Cooke's *Flora* the generic description of the flowers reads: "Flowers unisexual or polygamous: Calyx 4-5-fid or partite, usually coloured. Petals O. *Staminal column*[6] bearing at its apex 10-30 anthers arranged in a ring without order." A point of morphological terminology arises out of this description, namely, are we right in calling the column which rises out of the centre of the calyx in the male flowers a *staminal column*? (in the strict sense). But, before we can dispose of this question it becomes necessary to examine the statement 'Petals O'. 'After an examination of numerous flowers in the various species dealt with, I find that this statement is, perhaps, not wholly correct, and needs explanation. Actually, though there are no visible petals, the petals are reduced and united to form a deep or shallow *corolline cup,* inside which, are the five rudimentary carpels. The anthers are poised on short thick filaments (almost sessile) on the margin of the corolline cup. In the female flowers the same arrangement prevails with the difference that, the ovaries are not (naturally) rudimentary and the anthers are reduced in size, but are *not sterile;* therefore the anthers in the female flower cannot be referred to as *staminodes,* which term implies *sterile* anthers. Under the circumstances the so-called *staminal column* in the male flowers, and the *gynophore* of the female flowers are both one and the same thing, namely, a *gynophore* in the strict sense of the term. Further remarks on the details of the flowers will be found under the specific heads.

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[1] Cooke, T., *Fl. Pres. Bom.*, vol. I (1901), p. 122.

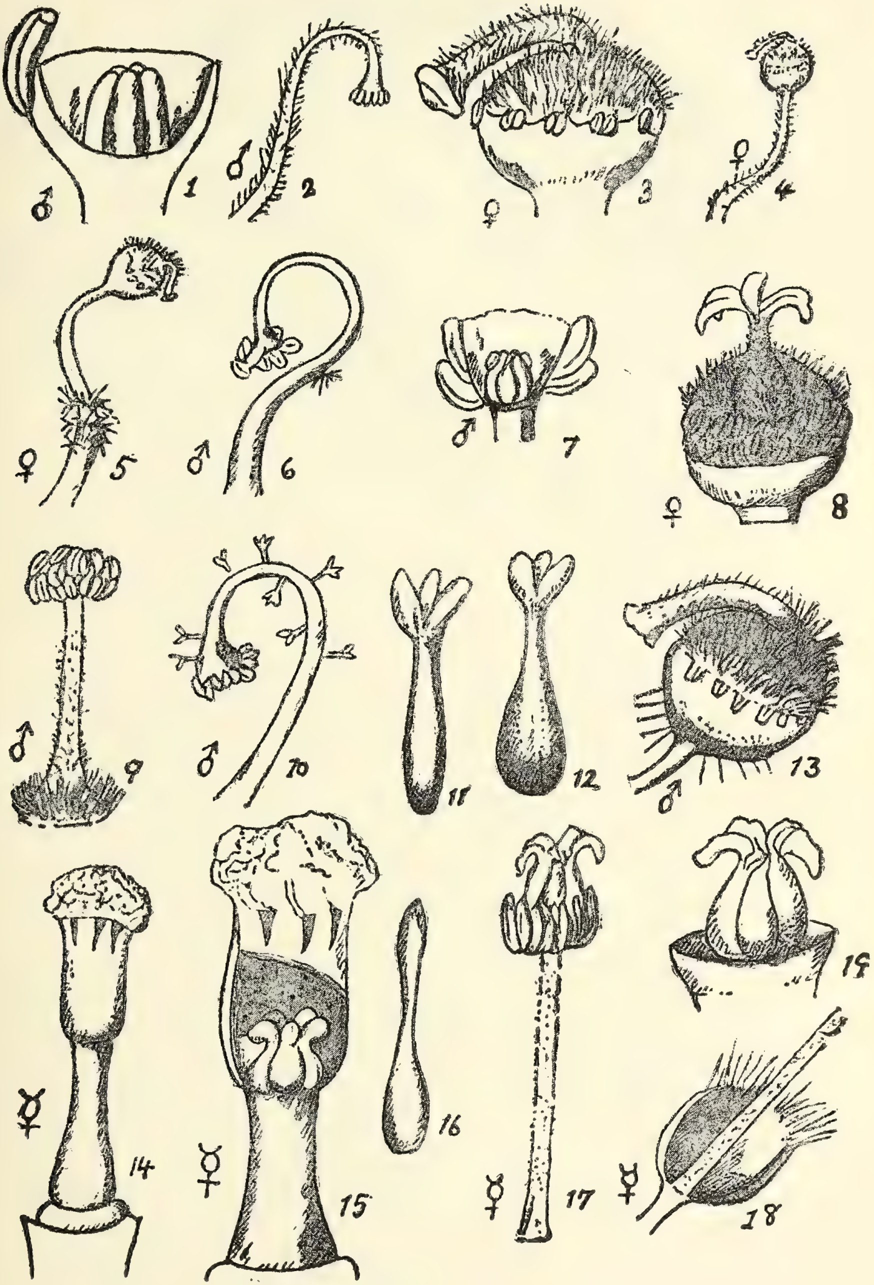
[2] Blatter, E., *Journ. B.N.H.S.* vol. xxxiv (1931) p. 876.

[3] Blatter, E., *Journ., B.N.H.S.* vol. xxxiv (1931) p. 876.

[4] Gamble, *J.S., Fl. Had. Pres.* vol. I (1915) p. 105.

[5] Fischer, C.E.C., in a letter.

[6] The italics are mine.



Del. C. McCann.

Gynophores of Sterculiaceae.

Sterculia foetida: 1. Corolline cup ♂; 2. ♂ Gynophore; 3. Pistil; 4. Gynophore ♀. *Sterculia guttata*: 5. ♀ Gynophore; 6. ♂ Gynophore. *Pterygota alata*: 7. Corolline cup; 8. Pistil; 9. ♂ Gynophore. *Sterculia villosa.* 10. ♂ Gynophore: 11 & 12. Glandular hairs; 13. ♀ Gynophore. *Sterculia urens*: 14. Gynophore; ♀ 15 as 14 opened: 16. Glandular hair. *Erythropsis colorata*: 17. ♀ Gynophore; 18. Base of corolla; 19. Corolline cup.

Genus: *STERCULIA* Linn.

1. **Sterculia foetida** Linn.

A curious feature of *S. foetida* is that whereas all the other species of the 'old' genus have simple leaves this species alone has digitate leaves.

Male flowers.—The male flowers are produced in great profusion and drop off from the proximal end of the pedicil. The sepals exhibits shallow oblong troughs on their inner surfaces which are glandular and function as nectaries. These areas secrete a foul-smelling substance. The margins of the troughs are bordered with inwardly directed, simple hairs. The gynophore is straight in bud becoming hooked soon after the opening of the flower. It is hirsutely ciliate almost to the base of the corolline cup. The corolline cup is somewhat irregularly toothed and supports the anthers on its rim. The anthers face downwards towards the central axis of the flower at the end of the hooked gynophore. This position of the anthers probably fascilitates contact with the pollinating visitors as they wander round and rise from the calyx after feeding. Within the cup are five rudimentary carpels; both the cup and the carpels are glabrous.

Female flowers.—The female flowers are comparatively few and are usually situated at the ends of the racemes. They are similar in appearance to the males, but with a corresponding enlargement of the carpels and a reduction in the size of the anthers. The gynophore, like that of the male, is hirsutely ciliate almost to the base of the corolline cup. The anthers are smaller and fewer, but are not sterile. The separations between the five carpels are marked by a dense villous growth of hairs. The style is also villous; in bud it is straight, but soon after the opening of the flower it elongates and becomes deflexed bringing the stigma to the level of the ring of anthers on the margin of the corolline cup. In this position the stigma is open to pollination by visiting insects, or to contact with the anthers on the rim of the cup. Crawling insects, such as ants, may also assist in pollination by the conveyance of pollen from neighbouring male flowers or by transferring pollen from the anthers to the stigma in the same flower, thus there appears to be a provision for both cross and self-pollination. On maturity of the flower, after fertilization, the calyx detaches from its seat and if it has not enveloped the young carpels on fading, it slides down to the base of the pedicil where it is only displaced on the enlargement of the pedicil in fruit.

The odour emitted by both male and female flowers is rather powerful, but if one does not get too much of a nose full it is somewhat similar to the odour of wild honey. It is not in any way as offensive as the odour emitted by the flowers of the next species.

Visitors.—The powerful odour emitted by the flowers attracts large numbers of carrion and fruit flies (*Diptera*), and other nectarivorous insects. The Blue Bottle Fly (*Pycnosoma flavipes*) is much in attendance. Among the *Hymenoptera,* the *Apidae,* honey bees, are frequent; ants also play an important rôle as they crawl over the flowers, especially *Cremastogaster* sp.

Follicles.—The follicles are large and woody; at first green turning scarlet, and finally a deep brown-purple when dry. The number of follicles on each gynophore varies from 1-5, apparently dependent on whether the ovules in each are fertilized or not. This is true of all the *Sterculias*. The follicles remain on the tree till the following deciduous period and lend a note of colour to the then bear branches.

2. **Sterculia guttata** Roxb.

The flowers of *S. guttata* are very similar to those of *S. foetida,* but there are very good differences worthy of note.

Bracts.—A character not mentioned in the *Flora* is the presence of a 3-fid bract at the base of each flower which covers it in bud.

Male flowers.—Male flowers are profusely developed, and are less deciduous than those of *S. foetida.* They frequently dry *in situ,* but eventually fall. The sepals are a lot more hairy than those of the previous species. The glandular areas of the sepals are beset with pyrimidal excrescences; at the summit of each pyrimid is a tuft of long hairs making access to the secreting tissue most difficult. The gynophore is much more recurved than in the previous species; it is entirely glabrous, except for one or two stellate hairs at about one-third its height from the base, and these are usually situated on the outer curve. The corolline cup is less well demarcated and its border is marked by the rather large anthers. In bud the gynophore is straight becoming strongly hooked after opening. Its position is like that of *S. foetida,* reflexed over the centre of the calyx.

Female flowers.—The female flowers are intermixed with the males over the whole length of the racemes. The gynophore is glabrous, except for a rather broad band of stellate at a level about one-third from its base. The separations between the carpels are marked by a dense villous growth of hairs. In bud the style is short and straight, but soon after the opening of the flower it elongates and becomes deflexed, bringing the stigma to the level of the margin of the corolline cup supporting the anthers; the style is also villous. The sepals dry in position.

Visitors.—The odour emitted by the flowers is most foetid; its intensity increases considerably after mid-day. Carrion flies appear to be the chief pollinating agents, and again *Pycnosoma* is abundantly in attendance. Ants also take a large share in pollination, more than one species being involved. In passing it might be mentioned that the odour of these flowers is so foul and overpowering that it penetrated through a thick cloth bag, and flies constantly sat on the bag in numbers. My fellow-passengers in the train who undoubtedly scented the flowers and watched the flies settle on my bag in profusion were uncomfortable and evidently suspected the contents of the sack!

Follicles.—The follicles are hard and woody, very similar to those of the previous species. They remain on the tree till the next deciduous period. In colour they are at first green changing to red and finally to brown. The seeds are black and polished. They are eaten by macaques and squirrels (*Funambulus* sp.); roasted or raw they are eaten by the local people. At the base of the seed there are a few irritant hairs.

3. **Sterculia urens** Roxb.

A striking field character of *S. urens* is its very pale exfoliating bark which may vary in tone through silvery white to pale yellow, and pale pink. This feature makes it stand out from all forest trees, particularly during the deciduous period of the year. The flowers of this species are somewhat differently constructed to those already described above, and although the *Flora* describes the male and female flowers separately, so far I have failed to obtain flowers that are *purely* male in spite of a careful search through numerous racemes. Another point of interest in this species is the presence of obclavate or somewhat dumbell-shaped hairs on the flowers: these hairs are flask-shaped below and slightly so, above, at the extremity.

Male flowers.—Exclusively male flowers not observed.

Female flowers.—Exclusively female flowers not seen.

Hermaphrodite flowers.—Hermaphrodite flowers are produced in great profusion, but comparatively few produce fruit for reasons which I shall endeavour to explain below. In the freshly opened flowers, the inside of the sepals are a beautiful rice-green and with age fade to a dirty yellow (hence perhaps the statement in the *Flora* that the flowers are 'yellow') with a bright red or scarlet central cup. The pollen is bright yellow. Externally the hairs on the sepals are doubly clavate or dumbell-shaped, forming a dense coating. These hairs are tinted a bright yellow or red. Internally the free portion of the sepals are clothed with dense simple hairs directed towards the tip; at the base of each lobe of the calyx there is a fringe of simple hairs directed towards the centre protecting the entrance of the cup formed by the union of the calyx lobes; at the base of the cup simple hairs, directed obliquely upwards towards the gynophore, guard the approach to the annulus or ring at the base.

The gynophore is glabrous, short, and approximately the same length as the corolline cup. At the base of the gynophore there is a pale yellowish collar or annulus (referred to above) of a glandular nature, and apparently functioning as a nectary. The corolline cup is almost equal in length to that of the gynophore. Within the cup are the five glabrous (apparently so at this stage of development) carpels. At the summit of the cup the anthers are united into a capitate head below which are four or five distinct slits or 'windows' which permit the ingress of minute insect visitors. The corolline cup may lose its head of anthers, split down and expose the stigmatic processes, or it may collapse *in situ,* and completely cover the carpels resulting in the sterility of the overies—no fruit is formed in such circumstances. Thus pollination in this species is somewhat more fortuitous than those with differentiated flowers, hence probably the comparatively few fruit produced by each tree.

Visitors.—The odour, unlike that of the species described above, is not evil-smelling. The flowers are visited by small *Diptera,* minute nectarivorous flies, which are able to enter through the 'windows'. These small flies apparently play the chief rôle in pollination. *Thysanoptera* (Thrips) are also present in abundance and may also serve as pollinating agents. Small spiders inhabit the inflorescences and weave their webs among the flowers; this may be largely responsible for the fact that the dried flowers are often seen on the trees long after the flowering season is over.

Follicles.—The surface of the young follicles is green; it is invested in a dense coating of velvet-like hairs which are glandular and irritant. The hairs become red, pass to tawny, and finally become brown.

4. **Sterculia villosa** Roxb.

S. villosa is a very inconspicuous tree in the deciduous state, and at times may quite easily be mistaken of *Odina Wodier* when bare. The lower portion of the trunk is often much knared. The tree often flowers when it is only a few feet high. In this species the racemes may be either purely male, or the sexes may be mixed, in which case the female flowers appear to be concentrated in the lower portion of the inflorescence. The main peduncles and pedicils vary from red-brown to bright scarlet.

Male flowers.—The male flowers are often somewhat smaller than the female. The sepals are a pale yellow (biscuit) or buff on the lobes with scarlet or pale red centres—the shallow cups formed by the union of the calyx lobes. The gynophore is strongly hooked with a few scattered glandular hairs on its upper half. The hairs are stout or somewhat flask-shaped below and each terminates in two to three lobules. The corolline cup is well demarcated.

Female flowers.—The female flowers are very similar to the males in colour, but are generally a little larger. The gynophore is glabrous. The corolline cup is well demarcated and has a few scattered, simple hairs at its base which are directed downwards. The anthers are small, but fertile. The five carpels are completely masked by a dense growth of villous hairs extending up the style, except for a glabrous path on its outer curve; the hairs on the style are less dense than on the carpels. The style is at first straight becoming deflexed soon after opening, thus bringing the head of the stigma to the level of the anthers on the margin of the corolline cup. The stigma is irregularly five-lobed.

Visitors.—Unlike the flowers of most *Sterculias,* the flowers of this species are agreeably sweet-scented. The narrow, bare path over the top (outer) curve of the style into the depth of the calyx cup sugests that it is intended as a passage for the entrance of visitors. Small flies, *Diptera,* ants, and bees (*Melipona* sp.) visit the flowers. *Thysanoptera* are also present. On examining the flowers, I have found ants and small flies moving round in the calyx cup in an attempt to find the path out again. The insects in their movements collect the pollen fallen in the cup, and from the anthers, and contact the stigma, thus effecting either cross or, self-pollination as the case may be.

Follicles.—The follicles are woody and much more boat-shaped than in either *S. foetida* or *S. guttata,* but like them turn scarlet when ripe and finally brown.

Genus: *PTERYGOTA.*

In this genus, although the flowers and fruit are very similar in general appearance, the style is distinctly 5-fid and the carpels are sessile, there being no gynophore in the female, although there is one in the male flowers. The gynophore in the male does not become hooked. The seeds are very broadly winged.

1. **Pterygota alata** (Roxb.)

The flowers of *P. alata* do not open wide as in the case of some of the *Sterculias* (*S. foetida,* for example), but remain in a half open condition. The normal number of calyx lobes appears to be six, rarely five or seven, the seventh often resulting from the splitting of one. The calyx lobes are divided to the base and do not form a cup by union as in the *Sterculias*—the *Flora* describes the calyx as campanulate! Each sepal terminates at its distal extremity in a distinct, somewhat wedge-shaped beak. Externally the sepals are clothed in a dense coating of tufts of hairs arising from the top of conical excresences; internally there are minute, scattered, stellate hairs adpressed to the surface.

Male flowers.—The majority of the male flowers are borne below the females which appear to be restricted to the top of the racemes. The gynophore is straight and about half the length of the sepals; it is never recurved or hooked; it is softly pubescent from the base to within a short distance of the corolline cup. Within the cup there are five, glabrous, rudimentary carpels with the styles strongly reflexed. The entire flower falls soon after maturation.

Female flowers.—The female flowers are usually borne at the distal extremity of the racemes and in general structure do not differ from the males. There is no gynophore. The greater part of the corolline cup is masked by bundles of large anthers. The five carpels are densely pillose and their divisions are imperceptible. The style is divided into five stigmatic arms after a short distance of union; it is softly pubescent. The stigmas are irregularly papillose and strongly recurved.

Visitors.—The odour emitted by the flowers of this species is reminiscent of the odour emitted by the crushed leaves of *Acorus Calamus,* and is not unpleasant. Ants and bees appear to be the chief agents of pollination.

Follicles.—The fruit is large and similar, in general external appearance, to that of *S. foetida.* The seeds are provided with a large oblique wing. The fruit remains on the tree till the next monsoon period.

Genus: *ERYTHROPSIS.*

In this genus the flowers are all hermaphrodite and the calyx is tubular. Another striking difference is the character of the follicles which are thin and papery with the seeds attached to the margins. In keeping with the great difference in the flowers there is a marked change in the agents of pollination as we shall see presently.

1. **Erythropsis colorata** (Roxb.)

Flowers.—As already noted there is no difference in the sexes of the flowers they are all hermaphrodite. The flowers are pendant, and the calyx is tubular and five-toothed. The gynophore is longer than the tube; it is stellately hairy. The corolline cup is shallow and supports on its margin the large sausage-shaped anthers; in its centre arise the five glabrous carpels which protrude beyond the cup. The stigmas are separate and each is bent back over its respective carpel; the stigmatic arms are somewhat lobate.

The construction of the flower and the profuse production of fruit in this species intrigued me for quite a time as it is so different in many respects to any of the others included under the old genus *Sterculia.* The method of pollination likewise puzzled me. The pollinating agents were known to me, but I could not solve the reason for the great fecundity observed for a considerable time. However, after much observation and dissection, I feel I have arrived at a solution. I have already described the construction of the corolline cup and its relation to the anthers and carpels, therefore, it only remains to explain certain details. In the freshly opened flowers the stigmas mature first and are exposed at the distal (top; *bottom* in the pendant position); the sausage-like anthers are free on their filaments and are easily brushed aside. At this stage the anthers are not dehesced. On dehescence the filaments and the walls of the anther cells contract, drawing the anthers up so as to form a close hood over the stigmas which by this time have possibly been pollinated by an early visitor. In the 'hooded' position the anthers alone are presented to subsequent visitors. At the same time it must be remembered that the freshly dehesced anthers may in the course of hooding the carpels possibly shed some of their contents on the stigmas, thus there is a possible provision for self-pollination should cross-pollination fail.

Visitors.—The flowers of *E. colorata* are not malodourous and they produce a very copious amount of nectar. They appear to be admirably designed for pollination by nectarivorous birds, such as Sun-birds (*Aethopyga* sp. and *Cinnyris* spp.) and the Green-Bulbul (*Chloropsis* spp.); these birds appear to be the chief agents. Other birds also visit the tree when in flower, such as Drongos (*Dicrurus*), but I am of opinion that these birds frequent the tree not to feed on nectar, but on the insect visitors which in themselves are nectar feeders. However, there is the possibility that ants (for they are often in profusion) also play the rôle of pollinating agents. *Thysanoptera* are also present.

Follicles.—The follicles have been described above so I need not repeat. They are short-lived on the tree for from the nature of their texture they soon dry and are blown away after maturation by the high winds that are usually prevalant at the time of the year when the fruit mature.

Note.—The cut ends of the branches of all the species mentioned above give out a thick clear muscilage when placed in water.

A curious difference between the species is that two out of the four *Sterculias* have foetid flowers, and two in which the flowers are not malodourous. This difference may be connected with differences in pollinating agents, for, *S. foetida* and *S. guttata* have open flowers which may be visited by the larger *Diptera* and *Hymenoptera* than in the case of *S. urens* and *S. villosa.* Although I have recorded the visits of bees for the last two species, I feel that minute *Diptera* and small ants are more suited as pollinating agents. I have also found the flowers visited by *Aphidae,* and as I have seen both nymphs and adults covered with pollen it is possible that they contribute to pollination also, however, more observation is required.

In the case of *Pterygota alata,* as I have remarked, the flowers do not open wide, as in *Sterculia.* They are not evil-smelling either. Flies are not in such abundance as in the case of *Sterculia* and the chief part appears to be played by Bees and ants. A significant point is that in these flowers the gynophore is straight and the sepals do not open to their fullest expanse. The visitors must apparently force their way into the flowers.

As I have already indicated above, the flowers of *Erythropsis* are peculiarly suited for bird pollination.

The flowers in all three genera open in the morning and usually fall by evening.

BREEDING AND DEVELOPMENT OF INDIAN FRESH-WATER AND BRACKISH-WATER FISHES.

BY

S. JONES, M.SC.,

PART II

(*With 2 plates.*)

(*Continued from Vol.* 46, p. 335.)

Cyprinodontidae.

Though the members of this family are of little value as food fishes their importance is great since they are the most efficient among the Indian larvicidal fishes. Notes on the spawning habits and development are given by a number of workers and we have a fairly connected account of the life histories of several species. Some of these have been introduced as aquarium fishes in foreign countries and we have notes on the habits and life histories of the fish there also.

Oryzias melastigma (McClelland).[1]

Jenkins (1910) recorded the fact that the eggs after extrusion remain attached to the vent till they adhere to some algal growth when the mother fish moves about. According to Raj (1916) who has given notes on the breeding habits of this form at Madras with the description of a newly hatched larva and the changes that take place during growth, this form is a perennial breeder with an intensive period from September to February. Chaudhuri (1923) has recorded egg carrying *O. melastigma* from Chilka Lake. According to Chatterjee (1934) the fish breeds throughout the year in tanks. Stoye (1935) gives the breeding temperature at 80°F. Jones (1937) has found this form breeding throughout the year at Adyar and Cooum in Madras and a fairly detailed account of the early development is given by him. The post-larval development is given by Job (1940). The interesting phenomenon of diapause noticed in the eggs of this species is given by Jones (1944).

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[1] *Aplocheilus melastigma* McClelland.

Aplocheilus panchax (Hamilton).[1]

Day (1878) refers to the large-sized nature of the ova and notes are given on the breeding habits of the fish by Chatterjee (1934) and the foreign aquarists like Innes (1935), Stoye (1935), Mellen & Lanier (1935) and Norlund (1936). A detailed account on the breeding habits and development of this form is given by Job (1940) according to whom it is a perennial breeder in Bengal with a maximum period during the monsoon months of June, July and August. The metamorphosis of the larva till the attainment of adult features is also given.

Aplocheilus lineatus (Cuv. & Vol.).[2]

Willey (1910) records his discovery of freshly extruded eggs of this form in July and refers to the presence of threads in them. Notes are given on the breeding habits of this fish by Moody (1933), Mellen & Lanier (1935) and Stoye (1935) in the aquaria. Job (1940) figures and describes unfertilized egg and the larval stages. The early stages in the development of the form are described by Jones and Job (1940). This is probably a perennial breeder.

Aplocheilus blockii (Arnold).[3]

Thomas (1887) refers to the large sized nature of the eggs of this fish under *Haplocheilus panchax*. The mature egg of this is figured and described by Raj (1916), Mellen & Lanier (1935), Innes (1935) and Stoye (1935) refer to the breeding habits of the fish in the aquarium. Russel and Jacob (1939) say that the fish does not multiply effectively in small pits containing water. Job (1940) quotes the works done by others on the breeding and development of this fish.

Aphanius dispar (Rüppel).

Day (1878) refers to the large sized nature of the ova of this fish.

Poeciliidae

Representatives of this family of viviparous Cyprinodonts are exotic to India and they have been introduced for larvicidal purposes from Tropical America. Their life histories have been worked out in many parts of the world and only brief notes and the relevent references are given in this paper.

Gambusia affinis holbrookii (Girard).[4]

Popularly known as 'Top Minnows', this fish has been introduced in different parts successfully for anti-malarial work. Mellen & Lanier (1935) and Stoye (1935) give an account of the breeding of the fish with a bibliography. It breeds when three to five months old and spawn only in warm (about 80°) fresh waters and is a continuous breeder in the tropics. Eight to thirty fry are expelled at a time and broods of 20 to 50 may be produced at intervals of four to ten weeks. Gopinath (1943) gives the breeding season in Travancore as from April to October with the maximum in June.

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[1] *Panchax panchax* and *Haplocheilus panchax* as known till recently.

[2] *Panchax lineatus*.

[3] *Panchax blockii* and *Panchax parvus*.

[4] Some regard *G. affinis* and *G. holbrookii* as separate species (Mellen & Lanier, 1935).

Lebistes reticulatus (Peters).

Though the 'Barbados Millions' have been introduced twice into India this is probably found now only in Ceylon (Hora & Mukerji, 1938). The fish begins to breed when nearly three months old and produces about 25 fry on an average in a brood. Older mothers are capable of giving forth 50 to 100. For six to eight months after copulation the females are able to give forth young ones even after separation from males. For further details and bibliography the works of Mellen & Lanier (1935) and Purser (1943) may be consulted. Stoye (1935) also gives some notes on the breeding of the fish.

Horaichthyidae [1]

Horaichthys setnai Kulkarni.

A very interesting and detailed account of the sexual dimorphism, breeding habits and early development of this fish is given by Kulkarni (1940) to whom also goes the credit for discovering this remarkable fish. The fish breeds throughout the year in Bombay, the peak period being July and August. The presence of spermatophores in the males is one of the interesting features described. The embryonic period is from 8 to 10 days. Some of the typical larval stages are described though it has not been possible to rear out the larvae in the aquarium.

Belonidae

The only knowledge we have on the breeding habits and development of forms belonging to this family is through the work of Job and Jones (1938) on *Tylosurus strongylurus*. Towards the end of November 1937 the author collected young Belonids of about an inch in length from the southern portion of Vembanad Lake, Central Travancore.

Tylosurus strongylurus (van Hass).

Eggs were collected by Job and Jones (1938) from the Adyar river in the middle of October 1937 during monsoon rains when the bar was open. The details of the embryonic development from the single-celled stage are given and the early larvae are described and figured. The eggs are laid singly attached to the algal growth in the river by the numerous filamentous threads found on the egg surface. Each egg is 2.5 mm. in diameter with transparent yolk devoid of oil globules. The hatching takes place on the 8th day. The larval and post-larval development are not known.

Hemirhamphidae

We have very little data regarding the spawning habits of the members of this family.[2] Bhattacharya (1917) gives a number of larval stages of *Hemirhamphus gaimardi* (*H. limbatus*) and Job and Jones (1938) three older stages of the same.

The author takes this opportunity to mention a serious mistake committed by him in a former paper (Jones, 1937) by describing the stages in the development of *H. gaimardi* under *Panchax parvus* (*Aplocheilus blockii*).[3] Meanwhile a mistake committed by Bhattacharya (1917) may also be corrected here. Of the 13 larval stages described by him under *H. gaimardi* (*H. limatus*) the first four stages are of some other fish while stages from 5 to 13 are of this form.

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[1] This family, named after Dr. S. L. Hora, is one of the most remarkable among the fishes recently discovered in India and a perusal of the account by Kulkarni (1940) is worthwhile.

[2] A marine form, *H. georgii*, is described by D. W. Devanesan in *Comptes Rendus*, XI (1935), pp. 2176-81.

[3] Fish was kept in water with some algae which was not carefully examined for any adhering fish eggs and next day some eggs were found which was incorrectly presumed to be the eggs of *P. parvus*. All similar eggs found later on were taken for granted to be those of the above species.

Hemirhamphus gaimardi (Cuv. et Val.).

The breeding habits and early development of this species at Madras are described under *Panchax parvus* (*Aplocheilus blockii*) by Jones (1937). It appears to have an extended period of spawning the most intensive being during the months of August, November and February. Eggs are round measuring 1.3 mm. in diameter and are provided with one to three long anchoring threads with which they are attached to water weeds. The hatching takes place usually on the eighth day.

Bhattacharya (1917) has described some stages of *H. gaimardi,* and Job and Jones (1938) have given three post-larval stages, older than the oldest stage given by Bhattacharya.

Dermogenys burmanicus Mukerji.

This form is supposed to breed all round the year 'as the young ones can be captured during all seasons' (Mukerji 1935).

Ophicehhalidae

There are a number of references regarding the breeding habits and development of the members of this family. Their parental care is well known and their nest, eggs and larvae are familiar even to laymen. According to Thomas (1870) they breed in South Canara in December and January and again in June and July. Khan (1924) says, 'The breeding season of Ophiocephalids in Punjab lasts from the middle of April to the end of July'. All species are monogamous. Eggs are laid in clear spaces among water weeds prepared by both the parents for the purpose. The eggs float in level with the surface of the water and the buoyancy of the egg is due to the presence of a single large oil globule occupying the greater part of the yolk. The eggs and fry are watched over by the parents for over a month till the young fish are capable of taking care of themselves.

Channa orientalis Bloch & Schneider.

Deraniyagala (1929) gives two localities in Ceylon from where he captured a mother with young, and a gravid female.

Ophicephalus marulius Ham. Buch.

Thomas (1870) makes a mention of the parental care of this fish. Khan (1924 & 1926) has given the breeding habits and development of this form in Punjab. He refers to the rapidity in the growth observed as compared with other species of *Ophicephalus.* The larvae grow better in the company of their parents and under natural conditions than in the aquarium. He has given in detail the changes that take place during the larval development. The fry after about six weeks lead an independent life. Seventeen weeks old fry measure about 118 mm. The mature fish grow to about 3 feet in length.

According to Derainyagala (1929) the breeding season in Ceylon is from April to June. He has given the dates of his collections of young fry from certain parts of Ceylon.

The age at which the fish attains sexual maturity is not known.

Ophicephalus striatus (Bloch).

Thomas (1870) refers to the parental care of this fish. In Mysore Colonel Puckle has observed this form to breed twice every year, in June and December, the male constructing the nest amongst the vegetation at the edges of tanks (Willey 1908). According to Willey there is an extended period of spawning in Ceylon before and after the rains. He noticed considerable disparity in the rate of development of the same brood. He has subsequently (1910) given the nesting habits and early development of this form. According to him the larval development is over by 40 days and the fry after 2 months begin to hide in the mud and lead an independent life.

Raj (1916) has described the early larva of *O. striatus* and has recorded some of the important changes that take place during the larval development. At Madras 1 year old specimens measure 6 inches and 2 year old specimens over a foot. The first spawning takes place when the fish is about 2 years old.

Oviposition according to Deraniyagala (1929) takes place several times in the year and he gives a number of places in Ceylon from where the larvae were collected by him with the dates and the length of the specimens.

The present writer has found the fish breeding in South Travancore, where it is quite common, in a remarkably intensive manner in May and June. Some broods were found in February after a shower.

Ophicephalus gachua Ham. Buch.

The breeding season is June and July in South Canara (Thomas 1870) and December and January in Madras (Raj 1916). Nests are probably built in sheltered crevices in the bank. Raj has given the description of the larvae from a young brood brought to him by fishermen. He could not see the large ocellus in the dorsal fin mentiontd by Day (1878). Khan (1924) has given a very interesting account of the actual spawning habit of this form. Deraniyagala (1929) lists two larval collections he made from two localities in Ceylon. The present writer has collected very young larvae of this fish from some of the hill streams in Travancore during the months of April and May.

Ophicephalus punctatus Bloch.

Day (1878) records about 4,700 large eggs in a specimen he examined in February. Willey (1908) has collected young specimens in Ceylon in April and May. Raj (1916) has described the breeding habits and development of this form. According to him it breeds twice in the year about January and February and again in July and August. The embryonic development of both *O. punctatus* and *O. striatus* is similar. The larval development is more rapid than in *O. striatus*. The larva of both the species can be distinguished by their characteristic larval coloration. The parental care is continued till the larval colours are lost. Deraniyagala (1929) mentions a number of places in Ceylon from where he obtained striped fry of this form with the corresponding dates. The writer has seen a large number of the broods of this fish in August and September at Saidapet, Madras.

Polyacanthidae

Polyacanthus signatus Gunther.

Deraniyagala (1929) records the collection of ovigerous females of *Polyacanthus signatus* Gunther in Ceylon.

Osphronemidae

We have accounts of the breeding habits of a number of fishes belonging to this family. The Osphromenids appear to be perennial breeders under ideal conditions. The nesting habits and parental care of these fishes are very interesting. Most of these are bubble nest builders except the Gourami (*Osphronemus goramy*) which builds a nest like that of a bird with water plants.

During mating time the sexually mature ones especially the males are adorned with beautiful coloration and play about, chasing one another. The male in the case of the bubble nest builders takes in atmospheric air and blows them out in the form of mucus-coated bubbles. These accumulate in one place in the shape of a circular dome. The female is attracted close to the nest by the amorous movements of the male after the completion of the nest. Then the vents of both the fish are brought into close apposition by the male coiling round the female and during this act the ova escape from the female which gets immediately fertilized by the milt produced simultaneously by the male. The fertilized eggs are transferred by the male to the nest of froth. This is repeated a number of times till oviposition is complete after which the female leaves the nest and the male remains in charge of it until hatching. The longevity of the air bubbles depends on the quantity of mucus contained and fresh bubbles are produced in the place of those that burst. The embryonic development of the eggs is over by three days and the young remain under the parental care for about a week after which they are able to swim about and lead an independent existence. Stoye (1935) gives general notes on the breeding of the bubble nest builders.

Osphronemus goramy Lacepede.[1]

The breeding habits under aquarium conditions recorded for this fish by Carbounier (1877) in Paris and by Gilbert (1904) in India are not actually of this fish as evident from the reports of later workers (Jones 1939 & Amritalingam 1939). Jordan (1905), Raj (1931), Roxas and Umali (1936), and Kulkarni (1943) refer to the bird-like nest made of water weeds. American aquarists so recently as in 1935 (Innes. 1935, Mellen & Lanier 1935 and Stoye 1935) refer to this fish as bubble-nest builders probably following the mistaken identity and description of former workers.

Regarding the work done in India Willey (1911) gives some notes on the larvae from Ceylon. Some notes on the breeding season are given by Raj (1916) and he has again made mention of the breeding season and nesting habits in some of the Administration Reports of the Madras Fisheries Department (1931-1939)—Kulkarni (1943) has recently given a fairly detailed account of that breeding habits and early development of this fish under Indian conditions. It breeds throughout the year in Bombay except during the monsoon from June to September. The nest is large and like that of a bird and is composed of water plants into which the lemon yellow eggs measuring from 2.2 to 2.4 mm. in diameter numbering about 2,000 are laid in batches. These hatch out in 10 to 15 days time according to the climate and the newly hatched larvae float with their yolk sac up due to the presence of a large oil globule. They are able to swim about by the fifth day. Stoye (op. cit.) says that the fish begins to breed in the 2nd year when it is about 5 inches long.

Trichogaster trichopterus (Pallas).

Baake (1930) gives notes on the breeding of this fish in the aquarium. Innes (1935) merely mentions that this fish is a bubble-nest builder and Mellen & Lanier (1935) say that the breeding habits are as in the case of *Colisa lalia.*

Macropodus cupanus (Cuv. et Val.).[2]

According to Thomas (1870) the fish breeds in May and June. The breeding habits and early development have been worked out by Jones (1940). The nesting habits and parental care are just as in *Colisa fasciata.* Probably it is a perennial breeder and eggs have been collected from tanks near Trivandrum during the months of January, February, April, May, July, September and October. Breeding is intensive during the pre-monsoon rains and in the intervals of bright sunshine between heavy rains. It makes a floating nest of air bubbles of about 2 in. diameter anchored to stalks of grasses and water plants in small clear spaces. The eggs are buoyant due to the attached air bubbles. Each egg is about 0.9 mm. in diameter and the surface is thrown into folds and ridges. Hatching takes place on the third day. Mouth and gill slits are developed on the 2nd day. Yolk is completely absorbed by the fifth day after which they lead an independent existence. There are about seven or eight transverse bands in the trunk in the young larva. The most interesting feature is the presence of cement glands (adhesive organs) in the early larvae. Mellen & Lanier (1935) say that the breeding habits of this fish is the same as in the Paradise Fish, *Macropodus opercularis,* though it is not so prolific as that. Innes (1935) refers to *M. cupanus dayi* (Kochler), which is evidently a variety of this fish, as breeding at 75°—80°F., in the aquarium, and Stoye (1935) says that it is a very hardy and prolific fish breeding at 75°F.

[3] *Colisa fasciata* (Bloch & Schn.).

A graphic account of the mating, nest building and parental care is given by Carbounier (1876). He made his observations under aquarium conditions in Paris where the temperature of the water was kept at 23-25°C. The same is recorded to have spawned in the summer of 1875, each time producing about 150 eggs. Innes (1935) referring to the breeding habits says that the bubbles are not so dense as in the other forms but scattered. He is not aware of the work of Carbounier (1876) and thinks that his account is the first record on the breeding habits of this fish. The eggs hatch at 78°F. in two days. Mellen & Lanier (1935) says that the breeding habits of this is same as in the Dwarf Gourami, *Colisa lalia*. *C. fasciata* breeds in April and May in the Punjab (Khan 1938).

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[1] Syn. *Osphronemus olfax* Cuv. & Val. For a more complete list of references on the breeding habits and development of this fish in foreign countries the papers of Jones (1939) and Kulkarni (1943) may be referred to.

[2] *Polyacanthus cupanus* of 'Fauna of British India, Fishes' by Day. The breeding habits of *Macropodus opercularis* is as in this form (Boulenger, 1932).

[3] *Colisa vulgaris* Cuv. & Val.

Colisa lalia (Ham. Buch.)

This is a bubble-nest builder and accounts of the breeding habits are given by Innes (1935) and Mellen & Lanier (1935). According to Innes (Op. cit.) bits of plants are also incorporated into the nest which the female also helps to build. He gives the distinguishing characters of the male and gives 80°F. as the breeding temperature. Mellen & Lanier (op. cit.) say that it breeds several times during summer at 75°F. and gives the diameter of the nest as five or six inches 'which the male guards with a jealousy that may prove fatal to the female if she is left in the breeding tank'.

Colisa labiosa (Day)[2].

Innes (1935) gives the breeding temperature in the aquarium at 80°F. and says that the eggs which are glass clear float up to the nest. Mellen & Lanier (1935) say that the breeding habits are the same as those of *C. lalia*.

Betta splendens Regan.

This is an exotic species introduced into India as an aquarium fish. There are two varieties of this pugnacious creature, the Siamese fighting fish and the Cambodia fighting fish. There is no record of the breeding habits in India of *B. splendens*. This is also a bubble-nest builder and the breeding habits are given by Waite (1904), Chute (1935), Innes (1935) and Mellen & Lanier (1935) and Stoye (1935). The account of the courtship and nuptials given by Mellen & Lanier (op. cit.) is graphic such as 'The female, treated like a child which may watch Santa Claus trim the tree but must not touch the contraptions, peakes out at her lord and master from some hiding place among the plants until he dons the most gorgeous coat for her admiring eye and invites her to view his masterpiece—the cradle he has built for her offspring which he proposes to sire'. From 200 to 350 eggs are laid and these hatch out in two days. The paternal parental care continues till the young ones are able to swim about and take care of themselves. The spawning temperature is 80°F. and at higher temperatures the fish breeds more frequently whereas at lower temperatures less often.

Anabantidae

Anabas testudineus (Bloch).

According to Day (1878-88) the breeding season extends from May to July. Willey (1911) obtained a gravid female late in January in Ceylon. Raj (1916) has given notes on the young fry and early development. According to him the young of this species grow rapidly though Willey (1911) records a much slower growth. According to Deraniyagala (1929) the fish breeds more than once. He describes the eggs and records the dates of collection of young fish in Ceylon. Innes (1935) says that it does not make a bubble-nest; but the eggs float at the water surface. Mellen & Lanier (1935) and Stoye (1935) also refer to the floating nature of the eggs which hatch in two or three days.

Mugilidae

Mugil sp[1].

Devanesan and Chacko (1943) have successfully reared marine mullets in freshwater by transferring the young fry. The change from the salt water to the fresh water may have to be done gradually.

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[2] *Trichogaster labiosa*. The breeding habits given by Carbounier (1877) as that of the Gourami are probably of this fish (Jones, 1939).

[1] The species is not given.

Polynemidae

Polynemus paradiseus Linn.

According to Day (1878) this form enters rivers for breeding purposes and generally during the S.W. monsoon and the cold months.

Ambassidae

Ambassis ranga (Ham. Buch.).

Day (1878) gives the distinguishing characters of the young of this form. Raj (1916) gives the breeding time as during the rainy season, sometimes as early as in March. Mr. Job has shown me young specimens of this form he collected from Adyar (Madras) in March 1938. He (Job, 1941) has referred to the breeding habits recorded by other workers in his account of the food and feeding habits of the glass fishes.

Ambassis miops Gunther.

Raj (1916) records the presence of the fry of this species in river Cooum in November and December and describes and figures them.

Ambassis lala (Ham. Buch.).

Baake (1930) gives notes on the spawning of this fish in the aquarium in his account of the rearing of this fish. Innes (1935), Mellen & Lanier (1935) and Stoye (1935) describe the breeding habits of the fish in the aquarium. The males are more brightly coloured than the females. Eggs are minute and transparent and are laid on finely divided plants in the bottom of the aquarium. About 40 eggs are laid at a time in batches of four to eight and it takes from 24 to 36 hours for them to hatch. The spawning temperature is about 82°F. and the fry cling to the plants or to the sides of the aquarium for about two days, which evidently shows the presence of cement glands in them.

Ambassis nama (Ham. Buch.).

This fish breeds in April and May in the Punjab (Khan 1938).

Latidae

Lates calcarifer (Bloch).

The breeding season of this fish is said to extend from January to March in the brackish water area (Raj 1916).

Theraponidae

The fry of the members of this family are known to migrate to brackish water areas and undergo development there.

Therapon jarbua (Forskal).

Rao (1934) has made a statistical study of the growth of this form at Madras. The first yearlings live in the brackish waters of Cooum and Adyar and the second in the open sea where they attain sexual maturity.

Therapon therapos Cuv. et Val.

Day (1878) gives a description of the young of this fish.

Pelates quadrilineatus (Bloch).

Day (1878) gives the larval coloration of this form.

Sillaginidae

Sillago sihama (Forskal).

Chaudhuri (1923) when describing the fish of the Chilka Lake says that the breeding season is probably about the month of February and that the fish goes out to the sea or near the mouth of the lake to breed.

Nandidae

Nandus nandus (Ham. Buch.).

Hamilton Buchanan (1822) says the fish breeds in January and February. According to Thomas (1870) the breeding season is in May and June when the fish builds nests among rushes at the margin of the water, deposits eggs in them and keeps guard over them. Stoye (1935) says that the temperature required is from 70° to 80°F.

Badis badis (Ham. Buch.).

Innes (1935) and Stoye (1935) give the spawning habit of this species and refer to the parental care of the male fish who guards and aerates the eggs which are laid attached to empty shells and flower pots and protects the young for a short period. Mellen & Lanier (1935) also give notes on the breeding habits of the fish. The optimum temperature is 75°F. and the embryonic period is about 3 days.

Toxotidae

Toxotes chatareus (Ham. Buch.).

Day (1878) gives the coloration of the young of this form.

Scatophagidae

Scatophagus argus (Gmel. Linn.).

This is a marine and estuarine form entering backwaters and rivers. Day (1878) describes the characters of the young of the fish.

Cichlidae

The breeding habits and development of the two familiar representatives of this family in India viz.,*Etroplus suratensis* and *E. maculatus* have been worked out by many and (as a result of which) we have at present a connected account of their life histories. The parental care characteristic in the family is found here also.

Etroplus suratensis (Bloch).

Day (1872) has referred to the coloration in the very young fish. Thomas (1870) has reported that the fish breeds twice a year in South Canara, in May and June and again in December and January. Willey (1911) gave notes on the nesting habits of this form in Ceylon where the fish is believed to breed 'from the middle of February to the middle of April and again about November'. Raj (1916) had recorded this fish to breed in April and May in Madras.

The most important work is that of Panikkar (1920) wherein he gives a brief life history of the form. According to him in Travancore the fish becomes sexually mature in the second year of its life and breeds twice a year, in May to June and again from November to February with a maximum spawning period in January. The observations of Panikkar go to show that the males play a greater part in the preparation of the nest for the deposition of the eggs, and of the pits for the transference of the larvae, whereas the actual work of oral transference is devolved more on the female. The parental care extends for a period of about 2 months. In a supplementary note by him (Panikkar 1924) he has recorded the capacity of the parents to breed twice every consecutive month if the spawn is removed immediately after deposition.

Jones (1937) has given notes on the spawning and development of this form at Madras with figures of some of the early stages. They were found to breed at Adyar in an intensive manner in July and August just after a few showers and before the opening of the bar. Eggs are oval and measure 2 mm. x 1 mm. and are laid attached to the sides of stones and other hard objects. They hatch out on the 4th day and are provided with cement glands. Both the eggs and larvae are assiduously watched by the parents. The papers mentioned may be referred to for details.

Etroplus maculatus (Bloch).

The breeding season, parental care and development are similar to that in *E. suratensis*. Jerdon (1848) first recorded the parental care of this form under the name *E. coruchi*. Notes in greater detail on the breeding habits and early larvae were given by Raj (1916) and supplemented later by Panikkar (1920) according to whom the fish attains sexual maturity at the close of the first year of its growth. Notes on the breeding of this fish in the aquarium is given by Baake (1929). A detailed account of the embryonic and early larval development is given by Jones (1937) as also the origin and development of the cement glands found in the early larvae (Jones 1937 a). He has observed this form to breed in August and September in the brackish water area at Adyar (Madras) and in May and June in Travancore where the breeding period appears to be extended. Mellen & Lanier (1935) and Stoye (1935) give brief notes on the breeding of this form in the aquarium. There is a recent account of the breeding habit of the fish in the aquarium by Rice (1943).

Gobiidae

The spawning habits and early stages of a number of gobies mostly from Madras are known. Eggs are usually laid in small holes and in crevices between stones etc., and among dense algal growth. Till the hatching time the male fish remains close to the egg mass guarding it and aerating it. The female leaves the nest soon after oviposition.

Gobius ostericola Chaudhuri.

Bhattacharya (1917) has described some embryonic stages of this form from the Chilka Lake collection. Their age is not known as the descriptions are from preserved materials. The specimens were collected from the oyster beds of Manikpatna in the outer channel of the Chilka Lake in the first week of December 1914. The water at that place was then almost fresh owing to the floods at the close of the monsoon, though later on in the dry season the water becomes as saline as in the Bay of Bengal.

Oxyurichthys striatus (Day).

According to Raj (1916) this species breeds from October to November in Madras. He gives the figures of eggs obtained by Mr. Wilson of the Madras Fisheries Department.

Ctenogobius acutipinnis (Cuv. et Val.).

Raj (1916) says this form breeds about February when the females were found to contain ova.

Glossogobius giuris (Ham. Buch.).

Willey (1911) has described the eggs and embryos of this form in Ceylon. Eggs were collected in the months of May, June and July. The breeding habits of this form in Madras with notes on the embryos and early larvae are given by Raj (1916). The spawning season here is from October to December. Mr. M. D. Paul has shown the writer eggs that he collected from the bank of a river (Thampravarni) in Tinnevelly in May 1936 with the male fish that was guarding them. He has said that the breeding season there is just after the recedence of the floods when the male fish can be caught in large numbers from holes in the banks while guarding the eggs. This fact is known to the local people and, some taking advantage of this parental solicitude, search for them inside submerged holes a typical example of ignorant and wasteful destruction.

Acentrogobius neilli (Day).

Raj (1916) remarks that this form is a perennial spawner with an intensive period about May and April. Aiyar (1935) has artificially fertilized the eggs and worked out in detail the early development. The eggs which are honey coloured measure only 0.4 mm. at the time of oviposition; but the egg membrane swells up to 1.2 mm. in about 15 minutes. Hatching takes place on the 4th day.

This is the most abundant goby in Madras and artificial fertilization experiments can be conducted successfully practically throughout the year though the most convenient time is just before the regular monsoon rains. It breeds both in fresh and brackish water and eggs have been collected by the present writer from between stones, algae, folds of poper, tiles and rotting leaves and timber.

Acentrogobius viridipunctatus (Day).

A detailed account of egg-laying habits and early development of this form is given by Jones (1937). This is a perennial breeder at Adyar, Madras, and eggs are generally found inside oyster shells and other narrow spaces with the male fish guarding them. Eggs are slighty larger than those of *A. neilli;* but the development is similar. The presence of true external gills in the embryonic stage is the most interesting feature seen (Jones 1939) as it is the first time a similar structure is recorded in a Teleostean.

Periophthalmidae

Periophthalmus cantonensis pearsi Eggert.

Pearse (1932) when dealing with the ecology of the Matla River says that in July he saw males with their dorsal fins erect chasing females about the flats. Probably this is a form of courtship.

Boleophthalmus boddaerti (Pallas).

Jones (1937) was able to artificially fertilize the eggs and note their development during the early embryonic stages after which all of them died.

Blenniidae [1]

Petroscirtes bhattacharyae Chaudhuri.

We have some knowledge of the eggs and young stages of this brackish water form. Bhattacharya (1917) has three young stages from the Chilka Lake. Jones (1937) has recorded its spawning habits and early development from Adyar, Madras. Eggs which are pink and dome-shaped, measuring 0.80 mm. in diameter, number about 900 and are laid in narrow spaces between stones and empty shells and the male keeps guard aerating them as in the case of the gobies. It takes from 12 to 15 days for the eggs to hatch and there is no parental care during the larval stage.

CONCLUDING REMARKS.

The incompleteness of our knowledge of the breeding and development of Indian fishes will be evident from the account given above. India being a large country with different climatic conditions the breeding season as well as the rate of development would necessarily vary as these depend to a very great extent on rain and temperature besides other related factors. This makes it imperative that the subject will have to be studied in all its various aspects paying due regard to the different physical and climatic conditions of the country.

A fact that must be borne in mind is that the mere presence of gravid females can never be taken as a true criterion for judging the exact breeding season. Though it may show that the fish is ready to spawn it need not necessarily follow that the fish should spawn immediately unless conditions are suitable for it. The mere superficial ripeness of the ova will not bring in the necessary sexual activity except perhaps in the case of the perennial breeders. Fertilizable eggs in the ovary and the presence of developing embryos and young fry in the waters inhabited by the fishes alone should as far as possible be taken as the proper criteria for judging the exact breeding period.

Most of the work done on the breeding and development of Indian fresh water fishes (Indian) has been done in South India and Ceylon, Madras deserving the place of honour. With the data available at present it is neither possible nor desirable (even should it be possible) to form conclusions. This can wait till the accumulation of more data as any conclusion that we arrive at can only be tentative, and alterable in the light of further investigation.

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[1] For a recent account on the development of blennies with comparative notes see S.S. Hilderbrand & L.E. Cables, 'Further notes on the development and life history of some teleosts at Beaufort', *Bull. Bur. Fish.*, U.S.A., No. 24, 1938.

India is far behind many other countries in aquarium keeping. While a number of beautiful fishes live unappreciated near us they are transported at great cost to foreign countries where they are valued and admired much. Fish is not exclusively a culinary article, but it is an object of beauty also. Aquarium keeping brings in its wake a desire to study the life history and habits of fishes and therefore it is necessary that every effort should be made to create a real interest in this hobby among those who could afford to take it up.

Life history studies form one of the most important branches of fisheries research and it is unfortunate that in India the problem has not received the attention it deserves. It is the improvement of the inland fisheries that should first of all engage our attention Under existing conditions an increased catch of marine fish will not improve to any appreciable extent the supply of fresh fish in the interior of the country in view of the transport difficulties. Unlike the conditions in the cold countries, putrification sets in very rapidly under tropical conditions, unless controlled mechanically with the aid of cold storage systems etc. which will be possible only in the large Indian towns connected by railways and other suitable transport facilities. A great disadvantage with this arrangement is that it makes the fish expensive and beyond the reach of the average Indian consumer. It needs no explanation to bring home the fact that it is by the improvement of the inland fisheries that we can increase the production of fish in the different parts of the country without substantially increasing the price of the commodity. It may be said here at the same time that the limitation of expansion in the case of the Inland fisheries are more than that of the marine fisheries even where in spite of the expansiveness of the waters and improvement of gear the catches remain more or less static after reaching a certain peak level if judicially controlled by international regulations, and would show signs of depletion if subjected to over fishing (Russel 1942)[1]. Though it may not be possible to meet all the demand for fish in this country by the development of the inland fisheries it would certainly be possible to augment the present supply to a great extent and thus derive the maximum benefit from the available resources. This does not however mean that the author is against the improvement of the marine fisheries. In the latter case we should first concentrate our attention on proper preservation and curing of the caught fish and quick transportation of it to the consuming centres so as to avoid any unnecessary waste as usually happens during the fishing season.

Dr. Worthington (1943) while making a spirited plea for the development of the fresh water fisheries in the British Colonial

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[1] 'Trawling and the stocks of Fish', *Nature*, vol. 151, p. 323, 1943.

Empire points out that compared to the marine fisheries the fresh-water fishery problem has received only casual attention at the hands of scientists as well as the Government. Though he speaks mainly of the possibilities of research and expansion of the inland fisheries of Africa the condition is equally applicable to India where though such large natural lakes as found in that continent are absent we have a good number of rivers, canals, tanks and artificial lakes offering immense possibilities of expansion in pisciculture. The Central Government advised by scientific bodies would certainly be doing a great service to the people by initiating work in this direction.

It may not be out of place here to indicate a suggestion for future work. As stated before, considering the magnitude of the work that remains to be done one can say without hesitation that we have not even touched the fringe of the problem. It is highly necessary that this work should be taken as an all India problem and itensive work should be done under a definite scheme for a certain period in a number of suitable centres in India with the co-operation of the Provincial Governments and of the important Indian States[1]. With the scientific data thus obtained we can proceed without much diffidence to adopt the necessary legislative measures to improve our fisheries, as the data we have at present are too scanty to serve any direct application. Meanwhile it will considerably add to our knowledge if all those interested in fish life will record their observations however short and insignificant they seem to be, in any of the scientific journals in India. As Willey (1908, p. 144) says, 'A knowledge of the breeding and swarming habits and periods of marine, estuarine and freshwater fishes must form the basis of intelligent action in regard to fish preservation and culture'. With the fervent hope that this paper will at least to some extent serve the purpose it is intended for, the author will conclude with the following remark of Dr. Stanley Kemp[2]. 'If there is one lesson to be learned from the history of Fisheries Research—one that cannot be too strongly stressed—it is that the opportunity of dealing effectively with a fishery problem will be generally lost unless its basic knowledge has been obtained in advance and is ready for application'.

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[1] Since completing this paper the author had the opportunity to see the interesting article entitled 'Zoological Research in Relation to Development of Fisheries' by Dr. S. L. Hora in *Current Science* (xiii, 4, pp. 95-97, 1944). wherein he states briefly the important lines on which investigations should be conducted in this country with a view to improving its fishery resources.

[2] Presidential address to Section D (Zoology) of the British Association, Cambridge, 1938.

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APPENDIX.

Since communicating the above for publication early in 1944 several articles on the subject have been published by various workers. These along with some old references that escaped the author's notice earlier are given below. The idea of giving brief extracts as before has been given up since the recent publications are available without difficulty in original for consultation.

Two plates containing figures of eggs and early larvae of some of our common freshwater fishes whose breeding and development are known are also given for reference.

Explanation of Plates.

Plate I.

Fig. 1.—*Etroplus maculatus* (Bloch). One celled stage 30 minutes after fertilisation. (×40).

Fig. 2.—*Etroplus maculatus* (Bloch). 48 hours old. (×40).

Fig. 3.—*Etroplus suratensis* (Bloch). Newly hatched larva. (×27).

Fig. 4.—*Garra ceylonensis ceylonensis* (Bleeker). Ripe unfertilised egg. (×16).

Fig. 5.—*Garra ceylonensis ceylonensis* (Bleeker). Embryo about 18 hours old. (×16).

Fig. 6.—*Garra ceylonensis ceylonensis* (Bleeker). Newly hatched larva. (×20).

Fig. 7.—*Petroscirtes bhattacharyae* (Chaudhuri). Egg first day. (×70).

Fig. 8.—*Petroscirtes bhattacharyae* (Chaudhuri). Larva 2nd day. (×40).

Fig. 9.—*Macropodus cupanus* (Cuv. & Val.). Egg about 6 hours old showing the blastoderm above and the yolk sac below. (×40).

Fig. 10.—*Macropodus cupanus* (Cuv. & Val.). Larva about 12 hours after hatching. (×30).

Fig. 11.—*Acentrogobius viridipunctatus* (Day). Embryo 36 hours old within the distended egg-membrane. (×54).

Fig. 12.—*Acentrogobius viridipunctatus* (Day). Newly hatched larva with the shrunken external gills behind the lower jaw. (×40).

Plate II.

Fig. 1.—*Ophicephalus striatus* (Bloch). Freshly laid egg. (×18).

Fig. 2.—*Ophicephalus striatus* (Bloch). Newly hatched larva. (×24).

Fig. 3.—*Danio malabaricus* (Jerdon). Egg showing blastoderm. (×35).

Fig. 4.—*Danio malabaricus* (Jerdon). Newly hatched larva. (×35).

Fig. 5.—*Osphronemus goramy* (Lacepede). Embryo 13 hours after fertilisation of egg.

Fig. 6.—*Osphronemus goramy* (Lacepede). Newly hatched larva. (×8).

Fig. 7.—*Horaichthys setnai* (Kulkarni). Embryo on the 4th day (Diagramatic without anchoring threads).

Fig. 8.—*Horaichthys setnai* (Kulkarni). Newly hatched larva. (×20).

Fig. 9.—*Mastacembelus pancalus* (Hamilton). Embryo 12 hours after fertilisation. (×22).

Fig. 10.—*Mastacembelus pancalus* (Hamilton). Newly hatched larva. (×24).

Fig. 11.—*Cirrhina mrigala* (Hamilton). Fourteen hours stage. (×10).

Fig. 12.—*Cirrhina mrigala* (Hamilton). Larva 9 hours after hatching.

Fig. 13.—*Oryzias melastigma* (McClelland). Egg on the first day showing the blastoderm. (×54).

Fig. 14.—*Oryzias melastigma* (McClelland). Newly hatched larva. (×24).

(Figures 1, 2, 3, 4, and 13 after the author, figs 5 and 6 after Bimachar and others, figs 7 and 8 after Kulkarni, figs 9, 10 and 14 after Job and figs 11 and 12 after Khan).

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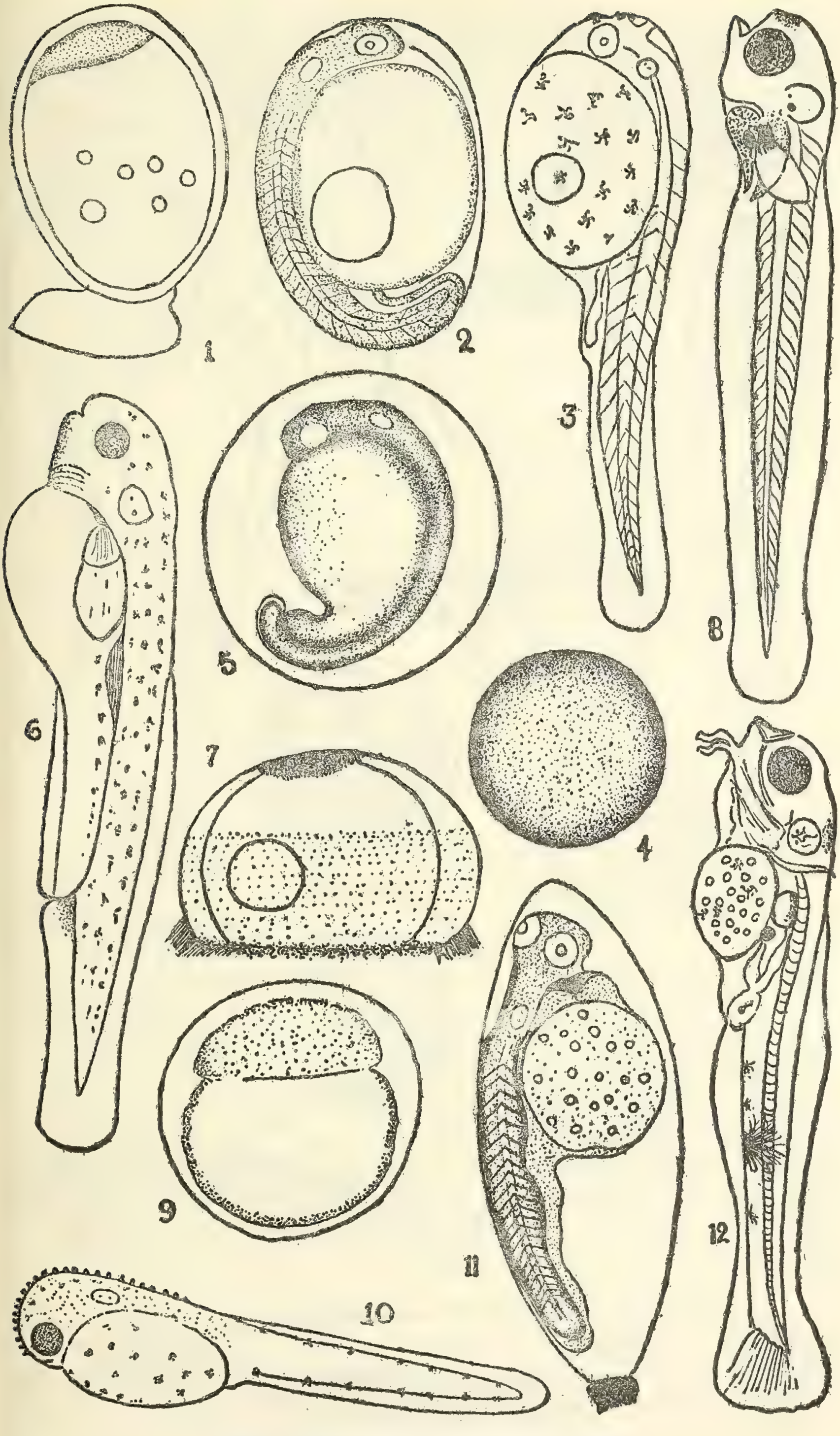
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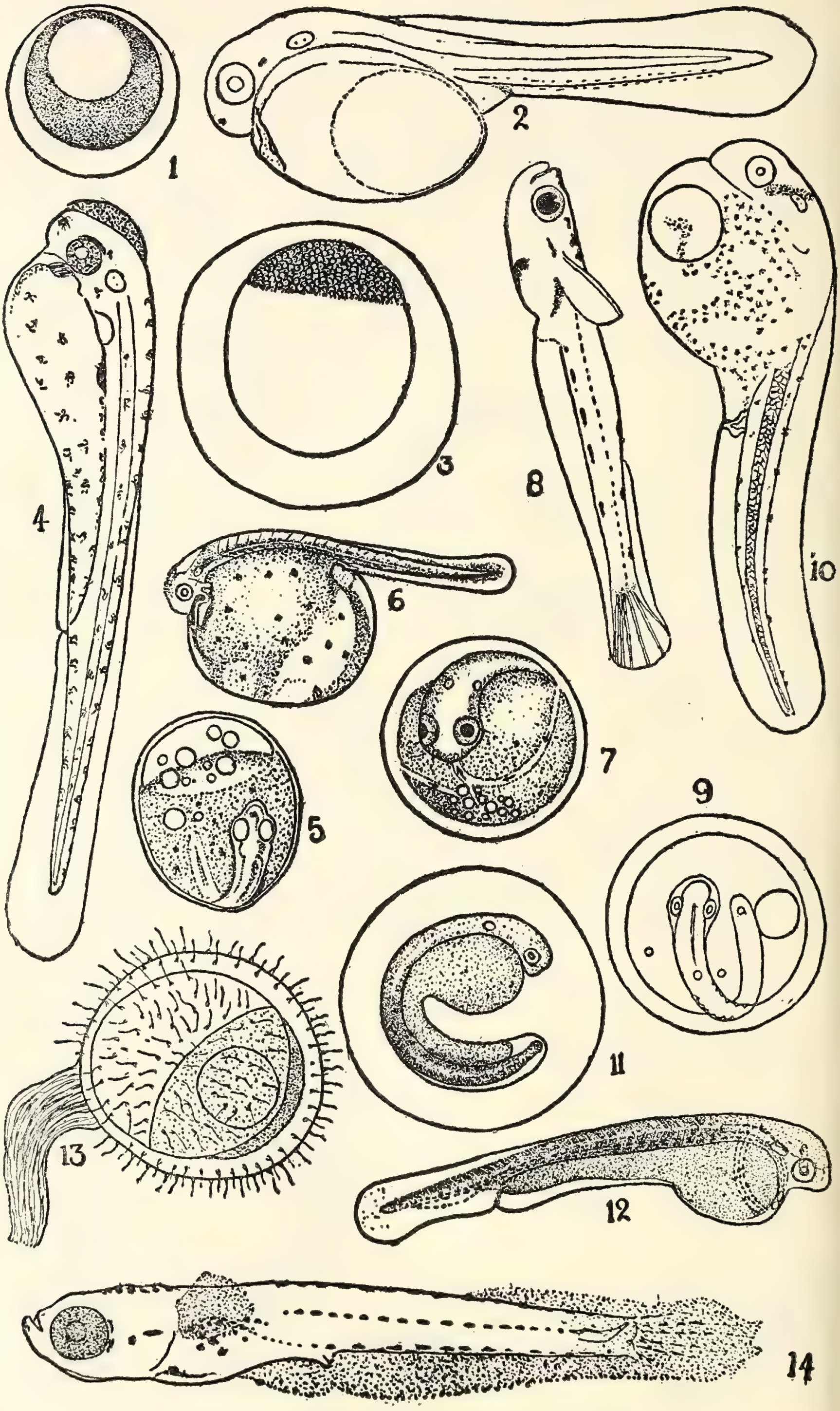
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Indian Freshwater and Brackishwater Fishes.

(For explanation see end of article.)

[1] Ahmad, N.—'The spawning habits and early stages in the development of the carp, *Labeo gonius* (Hamilton) with hints for distinguishing eggs, embryos and larvae of *Labeo gonius, Cirrhina mrigala* and *Wallagonia attu.' Proc. Nat. Acad. Sci. Ind.*, X, 3, 1944, pp. 343-354.

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[1] Some letterings in certain figures in this article evidently needs alteration.

@ It is said in this note that 'It is common for the parents to follow these schools till the fry attain the size of about 2.5 cm'. I have seen both adults and very young larvae of this fish in pools in hill-streams living quite independently without any evidence of parental solicitude.

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THE WILD ASS OF KUTCH.

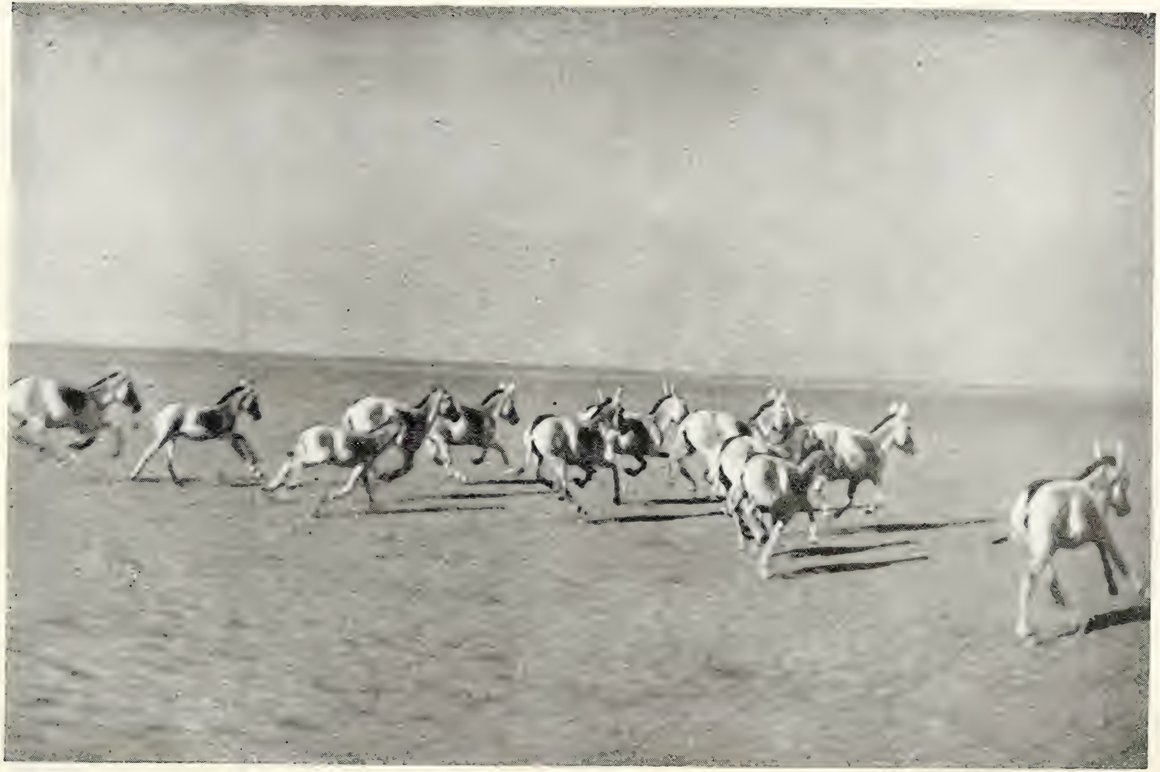
BY

Sálim Ali.

(With 2 plates).

Apparently little is on record concerning the taxonomy and bionomics of the wild ass that inhabits the Little Rann of Kutch. Mr. R. I. Pocock, who is revising the Mammalia volumes in the Fauna of British India series, found difficulty in assigning the precise relationship of this species to the Wild Asses of Baluchistan and Persia owing to the lack of suitable material in the British Museum for a critical examination. He asked the Society if they could obtain fresh specimens for the purpose. His Highness Maharao Shri Vijayarajji, whose patronage of Natural History is so well known, offered with his accustomed generosity to provide all facilities to any expedition the Society might send up to investigate the life history of the wild ass in his territory. The following notes, scrappy as they are, were made during my short camp on Pūng Bēt in the Little Rann of Kutch between 24 February and 3 March 1946, principally in order to procure the desired specimens. They are partly from personal observation, but largely from

THE WILD ASS OF KUTCH.



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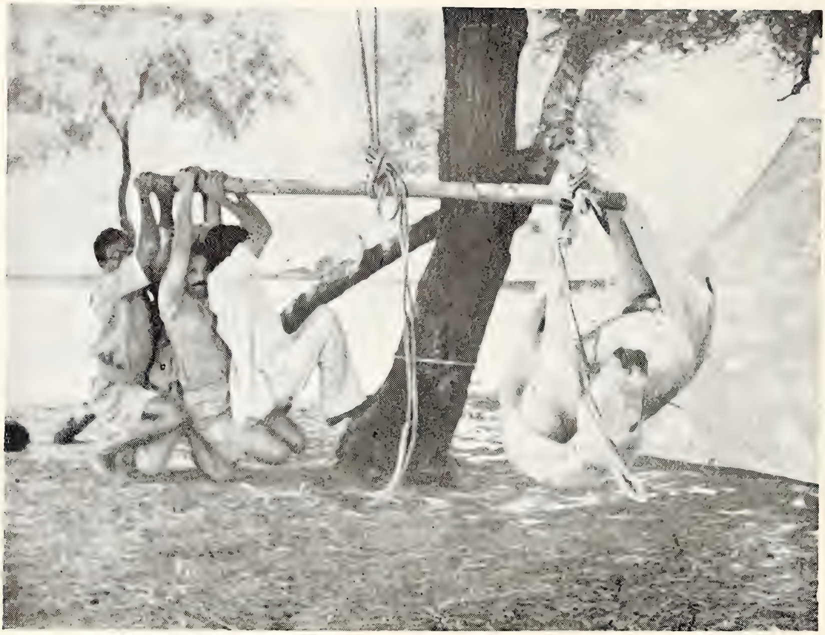
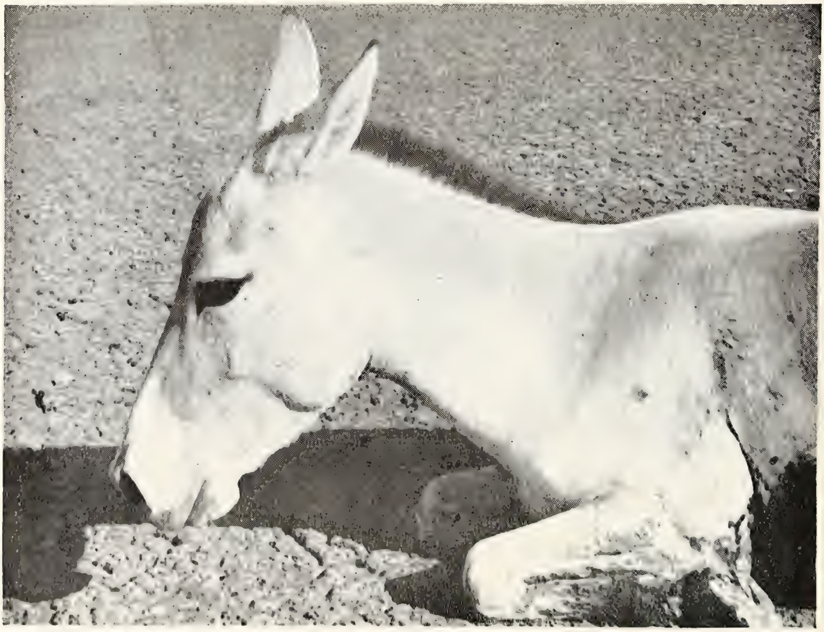
Wild Asses on the Rann.



A rough and ready method of weighment.



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Close-up of wounded female.

a sifting of local evidence which, on the whole, I considered to be trustworthy.

Habitat and Locality Factors.—Pūng Bēt (lat. 23°30'N × 71°15'E), the headquarters of the Kutch Wild Ass as it may be called, is an irregular shaped flat, sandy, grass-covered 'island' in the Little Rann, about 8 miles long (NE-SW) and 2 miles at its widest part. It lies 18-20 miles WSW of Ādesar in Kutch. Other similar *bēts* or islands in the neighbourhood are: Dhūtari Māta (in Rādhanpūr territory), Sāntalpūr, Shedwa, Mērdhak, Kesmari, and a number of smaller ones. All these are within the present range and habitation of the wild ass, roughly between lat. 23°7'N and 23°45'N × 72° to 72°42'E. They are included in an area of about 40 miles by 20, or 800 square miles. The *bēts* actually are the gradual accumulations of sand and silt brought down by the Banās River which enters the Little Rann in a south-westerly direction, about 12 miles NE of Pūng Bēt, and sprawls out over the pancake Rann as a vast expanse of shallow water of variable width. It is several miles wide in places, depending upon season, but scarcely ever more than 2 ft. deep anywhere, usually only a few inches. The water is brackish due to the seasonal extension inland of the Gulf of Kutch and its mingling with the waters of the Banās. Thus, when dry, the hard surface of the Rann is covered with a fine saline encrustation.

As soon as these sandy accumulations have risen barely a few inches above the level of normal monsoon inundation, the foremost plant colonists make their appearance: the "Lāna" (*Salsola*) and the scraggy "Khārio" grass (*Ælurops villosus*). Ecological succession duly follows, and on the higher and older portions of the *bēts* is found a fairly luxuriant growth of several species of grasses, some of which furnish the chief food of the wild ass.

Further inland from the edge of Pūng Bēt, Babūl (*Acacia arabica*) has established itself and appears to be increasing. As yet there are only scattered groves, here and there, of small or medium sized trees around shallow natural depressions bunded by the Forest Department. These fill up to form miniature tanks during the rainy season and help to conserve some moisture.

Numbers and Population of Wild Asses.—I estimated that the population of asses within a 5-mile radius of Pūng Bēt at the time of my visit was about 200 animals. As the Banās waters dry up, leaving the Rann arid, and the grass on Pūng and other *bēts* becomes exhausted (after about the middle of March) the asses shift to 2 other *bēts* viz. Vāchhda (Rādhanpūr territory) and Jhilandan (Jhinjūwāda Jāgir). The latter is about 12 miles distant from Khārāghōda in Ahmedābād District. On these *bēts* or 'islands' there is perennial water and some green grass to be had all the year, and the concentrations of wild asses here at the end of the pre-monsoon season (as also in drought years) are said to be enormous.

In the rains when the Little Rann is again inundated and fresh pasture available on the islands, aggregations of over 500 animals are said to be based on Pūng Bēt whence they wander across freely to the neighbouring *bēts*. They are said to be abundant over the entire area as above defined, one fairly reliable and allegedly conservative estimate putting them down as between 3000 and 5000 individuals. According to local testimony the general population is increasing year by year.

Breeding.—Copulation takes place in August/September/October. A mare on heat separates from the troop with a stallion who fights viciously with interlopers for possession, the combatants rearing up on their hindlegs using hoof and jaw. After a few (?) days of isolation the couple rejoin the herd, and thereafter the female actively resists advances by other stallions. The period of gestation is 11 months. Foals (only a single) are dropped July/August/September. Until the foal is about 3 months old the sexes live apart in separate herds, or troops. These particulars seem to be confirmed by the fact that most colts accompanying the mixed troops of adults between 24 February and 3 March were, like Specimen No. 4, estimated to be about 8 months old, and therefore born about July/August. Some may have been up to a month younger. Further, both the adult female specimens—No. 1 & No. 3—were gravid, the former with a female foetus about 6 months old, the latter also with a female foetus about 5 months old.

At the time of my visit there were no very young foals accompanying the troops, but a fair number—about 6 to 8 in every troop of 20 to 30 animals—of colts about 8 (to 12?) months old, and all more or less uniform in size with No. 4. Mares seemed to predominate in the troops.

Enemies.—No epidemics appear to be known among the wild asses. Even severe droughts are tided over by widespread dispersal, and natural predators are practically non-existent. A certain number of young foals may fall a prey to wolves, but the dams are said to defend their young with great pluck and determination. As to humans, few people appear to molest them and they are seldom shot for food or other purposes (the male genitals are believed to possess aphrodisiac properties), except by certain tribes from Sind, and that not extensively. Indeed from the nature of the terrain they inhabit, shooting wild asses except from a motor car cannot be a simple business. Therefore, for the time being at any rate, the wild ass seems fairly safe against any wholesale persecution. Most local castes, even the lowest, will draw the line at ass meat, a prejudice that seems difficult to account for. In view of it however, it may be interesting to record that for the best part of the week spent in their pursuit, I and my party lived largely on the meat of the asses I shot—roasted and curried—and that I found it quite agreeable. To me it tasted very like Blackbuck, and it is certainly no coarser than Nilgai. In the interests of Science it is indeed fortunate that the taboo exists. There is no doubt that otherwise the wild ass would have followed hard on the heels of the Blackbuck which is now all but exterminated in many parts of the Rann and Gūjarāt where it abounded only a few years back.

No wholesale deaths such as caused by an epidemic or drought have been reported. During his 40 years' experience, Chatar Singh, the Forest Guard of Pūng Bēt 'Rakhāl' (or forest reserve) for the last 20 years, whose information generally proved to be quite reliable, has never come across a dead wild ass, or heard of any save an occasional stallion that has been killed in fight with a rival. That the fights are often bloody is evident from the fact that quite a number of stallions in the troops I met had lost the ends of their tails, often leaving merely a short stump. Several had bits of their ears bitten off as well, and the many old scars on their bodies were doubtless also the result of such encounters. Specimen No. 2—a battle-scarred and aged veteran—had in addition lost one eye.

Food.—The grasses which provide the staple food of the wild ass, in order of preference, are: 1. "Chaklādūn" (*Eragrostris amabilis*), 2. "Khīvai" (*Eleusine flagellifera*), 3. "Bharōd" (*Apluda aristata*) and 4. "Jinjvo" (*Andropogon ischiemum*). When paddy, wheat and gram crops are ripening along the edge of the Little Rann, troops of asses invade the fields at night and are said to cause considerable damage. They bite off the formed ears of grain and leave the plants intact.

General habits.—During the daytime the asses mostly roam over the barren expanse of the sun-scorched Rann in troops of 10 to 30 individuals (in one instance over 50 !), but also in twos and threes and even solitary as in the case of Specimen No. 2—a very old stallion. They do not appear to mind the mid-day heat (maximum registered 100°F in the shade on 28 Feb.), and never seem to take refuge under the shade of the babūl groves as, from footprints and droppings, the local Blackbuck evidently do. When visiting the *bēts* at dusk to graze—which they leave again for the open by sunrise—they seem to prefer the grassland along the periphery of the islands. At the season of my visit this may partly have been in order to escape the biting day flies which were abundant and troublesome.

On the regular nightly gathering places on the grassy edge of the *bēts* the ground is reduced to bald 'pats' in patches, with the grass trampled flat or worn away. Large quantities of dung are strewn about, and marks where the animals have rolled in the soft loose earth are frequent. Here also are to be seen the 'drag marks' such as I have described in the case of the Tibetan Kyang on p. 396, Vol. 46 of the *Journal.* These are commonly between 5 and 10 feet in length, and one measured over 30 ft. As in Tibet, the locals averred that they were made by an ass (male or female?) dragging one of its hoofs along the surface, but why the animal did so or under what circumstances was unexplained.

The herds keep to the higher and drier portions of the *bēts* during the rains when the Rann is under water. During this season they freely wade across from *bēt* to *bēt.* The young foals can be driven out into the squelchy inundated Rann, easily tired out to a standstill in the soft mud, and then captured. They are readily tamed if taken young, but are apparently recalcitrant and vicious when grown and cannot ordinarily be trained to harness. It will be seen from the measurements of the specimens that full grown animals stand nearly 12 hands at the shoulder—the height of a good sized mule. They are sturdy and fleet of foot, and I feel that mules bred from them should prove a satisfactory proposition. It certainly seems an experiment well worth attention.

When pursued in a motor car and going all out, I found that the animals could maintain a speed of 30-32 miles per hour over a considerable distance. The longest neck-to-neck race run was about 1½ miles. The animals had already done a mile or more before they were caught up with, and showed no signs of tiring when I left them. Sometimes the troops of asses were mixed with a few Blackbuck, and it was interesting to observe how effortlessly they were outdistanced by the buck when chased by the truck. With the truck doing 40 m.p.h. the buck steadily ran away from it while the asses were gradually overhauled. The colts kept up with the troop for some time, but gradually dropped behind when hard pressed. Gravid mares, like the 2 specimens, appeared to keep up with the troop without difficulty. A point that struck me as surprising was the great difficulty in picking out males from females when the animals were going all out even from so close a range as 25 or 30 yards behind! The testes of the stallion are drawn up almost flush with the belly, so that in size and appearance they are almost indistinguishable from the immature udders of the mares.

According to local information wild asses drink regularly. In February and March there is usually some slightly brackish though potable water in two *kutcha* wells on Pūng Bēt, but this cannot be accessible to the animals. On many of the other *bēts* there is no water at all out of the rainy season. The asses drink chiefly at the Banās River close by, where there is normally plenty of water till about mid April. At what intervals the animals drink, or whether at fixed times, I was unable to determine.

The wild ass is said to produce a call which was described to me and reproduced by a local. It sounded something between the neigh of a horse and the bray of a donkey, but in rather an unnaturally high key. I cannot vouch for the faithfulness of the 'recording'.

PARTICULARS OF SPECIMENS COLLECTED

Specimen No. 1 Gravid ♀ with ♀ foetus ca. 6 months old wg. ca. 10 lbs. Said to be 8 to 12 years old. In prime condition, and very fat. No milk in udder.

Date 24 February 1946

Measurements:

Length: Head & Body (round curves)	7′-3 3/8″
,, (between pegs)	6′-11 7/8″
Tail (without hairs)	1′-0 7/8″
Ear (without hairs)	0′-7 7/8″
Height at shoulder	4′-2 7/8″
Weight (approx.)	775 lb. (? probably inaccurate)

Specimen No. 2 Old solitary stallion, said to be about 25 years old. Blind in left eye. Part of tail missing. Bits of both ears chewed off. Front lower teeth worn to stumps.

Date 25 February 1946

Measurements:

Length: Head & Body (round curves) ...	7′-0 7/8″
,, (between pegs) ...	6′-10 7/8″
Tail ...	stump
Ear (without hairs) ...	0′-7 3/8″
Height at shoulder ...	4′-0 7/8″
at rump ...	4′-2 7/8″
Weight (approx.) ...	525 lb.

Front hoof: back to front 9.5 cm; across (side to side) 9.5 c.m.

Specimen No. 3 Gravid mare with ♀ foetus ca. 5 months old wg. ca. 6 lb. Said to be 8 to 10 years old. Fine condition. Udder produced ½ cupful of milk!

Date 27 February 1946

Measurements:

Length: Head & Body (round curves) ...	6′-9 7/8″
,, (between pegs) ...	6′-9 7/8″ (?)
Tail (without hairs) ...	1′-2 3/8″
Ear (without hairs) ...	0′-7 3/4″
Height at shoulder ...	3′-8 3/8″
at rump ...	3′-10 3/8″
Weight (approx.) ...	450 lb.

Specimen No. 4 Colt (♂) said to be 8 to 12 months old.

Date 27 February 1946

Measurements:

Length: Head & Body (round curves) ...	5′-5 7/8″
,, (between pegs) ...	5′-4 3/8″
Tail (without hairs) ...	1′-0 3/8″
Ear (without hairs) ...	0′-6 3/4″
Height at shoulder ...	3′-3 7/8″
at rump ...	3′-6 5/8″
Weight (approx.) ...	185 lbs.

Specimen No. 5 Adult ♂ said to be 10 to 12 years old.

Date 28 February 1946

Measurements:

Length: Head & Body (round curves) ...	7′-0 3/8″
,, (between pegs) ...	6′-11 7/8″
Tail (without hairs) ...	1′-3 7/8″
Ear (without hairs) ...	0′-8 1/4″
Height at shoulder ...	3′-11 5/8″
at rump ...	3′-11 7/8″
Weight (approx.) ...	525 lbs.

N.B.—All weights taken on an improvised beam scale against men subsequently weighed on weighing machine.

SOME SUGGESTIONS FOR FIELD ORNITHOLOGISTS IN POST-WAR BURMA.

BY

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PART I.

Many of the ornithologists who worked in Burma up to 1941 have left the province and are not likely to return. In spite of Major B. E. Smythies's most excellent book, *Birds of Burma*, which it is hoped will soon be reprinted, a great deal still remains to be discovered about even our commonest and most conspicuous birds, as any working naturalist knows. In the hope that my suggestions may assist others who may be scattered all over Burma in the post-war years, and whose opportunities for collection are limited, I have compiled this paper. I have expressly excluded the birds of the higher hills and also Tenasserim, because the avifauna of both is in many ways highly specialized and I am personally unfamiliar with the Tenasserim division south of Thaton. But as no one has collected, or recorded notes seriously in that region since Davison, in the 'eighties, I am quite sure that any naturalist stationed there has a great chance to make history. None of the birds mentioned in Part I of this paper present much difficulty in identification.

Racket-tailed Magpies (**Crypsirhina**).

The grey hooded bird (*cucullata*) is mainly a bird of the dry zone though it extends north to the Myitkyina plain and south at least to the Kyangin township of Henzada. It would be interesting to know what is the full range of this bird and where that of the black species (*varians*) overlaps, as it appears to do in Yamethin district.

Magpie (**Pica**).

The Magpie (*Pica pica*) occurs west of the Irrawaddy in small numbers at Myitkyina. Does it do so anywhere else in Burma and what is its range outside the Kachin Hills and Shan States?

Jays (**Garrulus**).

The hill-jays are, in my experience, rare and shy birds. The Burmese Jay (*G. leucotis*) is said to occur from Bhamo district all along the eastern hills and also in Central Burma and the Upper and Lower Chindwin (Mears). In Oates's day it was said to be a plains bird in Toungoo district. A further check on its distribution seems desirable.

White-throated Babbler **(Argya gularis)**.

This is a dry zone bird which occurs as far south as the Henzada district and I have seen individuals on three occasions near Mingaladon. Any occurrences outside the dry zone are of interest.

Black Bulbul **(Microscelis)**.

There are three races in Burma, black, very dark gray, and black with a white head. The occurrence of white-headed birds anywhere in Burma should be noted, and whether they are in the company of black or dark gray birds.

Stonechat **(Saxicola torquata)**.

The breeding race in Burma is the white-tailed (*leucura*) which is a bird of the *kaing*-grass at a low altitude along rivers. I do not think that any other race of stonechat has been found breeding for certain in Burma though pairs of the Yunnanese race undoubtedly do in the mountains of Myitkyina and should be looked for elsewhere.

Paradise Flycatcher **(Tchitrea paradisi)**.

Very little is on record about this bird's breeding and movements in Burma. I certainly saw males in full plumage in Shwebo in 1921 and in Myitkyina and it used to be a common migrant in September or October in Lower Burma.

Fantail Flycatcher **(Rhipidura)**.

The species inhabiting the mangrove-jungle along the Hanthawaddy and Myaungmya coasts is not known, and specimens are desirable.

Black Drongo **(Dicrurus macrocercus)**.

This common bird becomes very silent and self-effacing in the breeding season. It certainly bred before the war in Henzada and the Yandoon island but any breeding records from Lower Burma are of value, as Oates never found it breeding. The same applies to the grey drongo about which there seem few, if any, breeding records.

Bunting **(Emberiza)**.

A watch should be kept for buntings which are often overlooked. The grey-headed bunting (*fucata*) and the easily-recognized yellow-breasted (*aureola*) occur all over Lower Burma in the 'open season' and probably the little bunting will be found from November to March in most districts. The occurrence of the crested bunting, which is very partial to seeding *kaing*-grass, and the chestnut bunting should be looked for.

Martin **(Delichon)**.

Between 1850 and 1934 there were no records of House Martins in Burma. Since then there have been 10 or 12 but any records are worth preserving.

Swallow (**Hirundo**).

Any breeding swallows in Burma are of interest, the most likely species being the small blue wire-tailed swallow (*smithii*) and the large striated swallow with a pale rump (*striolata*). A watch should be kept for *tytleri*, with deep rufous underparts which appears irregularly on migration, and also for roosts of swallows. I have seen birds apparently flighting to roost on many occasions but have never discovered where they go.

White Wagtail (**Motacilla alba**).

Does this bird breed anywhere in Burma? I have seen pairs at a low altitude near the Confluence in Myitkyina which I felt sure were breeding but the only Burmese nesting record is unsatisfactory.

Ganges Sand-Lark (**Calandrella raytal**).

The distribution of this pale lark whch seems confined to sand banks on the rivers of Burma needs working out, particularly its northern and southern limits and its possible local migrations or absence in the rains.

Skylark (**Alauda**).

Any Skylarks singing or paired in the Burma hills are of interest, though, as is well-known, the Indian Skylark (*Alauda gulgula*) breeds on the riverine plain of Lower Burma, especially in peafields.

Black-capped Kingfisher (**Halcyon pileata**).

This is a common and most conspicuous Kingfisher on *tidal* waters in Lower Burma. It undoubtedly migrates to breed in the foothill streams of e.g. Henzada, but its movements away from the tide are not well recorded; Mears, for example, recorded it as found throughout the Upper and Lower Chindwin. It would appear to be a migrant and, if so, very little is on record about its arrival and departure from its breeding-haunts.

Blyth's Kingfisher (**Alcedo hercules**).

This bird has been obtained by me twice, once in the Prome-Arakan hills near Nyaunggyo, and once in Putao, on forest streams. It is a large kingfisher, in colour resembling the common kingfisher but about twice the size. It is difficult to believe that it has not a wide range between these localities, and watch should be kept for it.

Blue-eared Kingfisher (**Alcedo meninting**).

I believe myself that this very brightly-coloured bird is the forest representative of the common kingfisher of our jheels and rivers, for which it can easily be mistaken, and that it is found in numbers in the streams of the Pegu *yoma*. Its distribution in Burma needs working out.

Trogons (**Harpactes**).

In 1939 I obtained Trogons in the Myitkyina hills which had been eating seeds, leaves, and vegetable matter though hitherto they had always been considered insectivorous. This point should not be difficult to clear up.

Nightjars (**Caprimulgus**).

These birds have an unexplained habit of sitting on roads at night, where they are frequently killed by motor-vehicles. There is some reason to think that they may be eating grit, and that Bee-eaters repair to forest roads in the evenings for the same purpose. I commend this possibility to any ornithologist who may chance to collect them.

Osprey (**Pandion haliaëtus**).

Does the Osprey nest in Burma? It has bred in Calcutta and Cachar, Harington suspected its breeding in Bhamo, and I have seen Ospreys in June and July in Myitkyina.

Sea-eagles (**Haliaëtus**).

Though I much deprecate shooting these magnificent birds in the breeding-season, the records of all sea- and fishing-eagles which occur in Burma are very unsatisfactory. At least three species are said to occur but I have found them very hard to identify accurately with field-glasses, though the bird of the Upper Irrawaddy is certainly *H. leucoryphus* (Pallas's Fishing-Eagle).

Raptores of the Dry Zone.

Macdonald found Bonelli's eagle breeding in Myingyan in January. Smythies states it has been found breeding at Sagaing. The breeding raptorial birds of the dry zone, especially the Laggar Falcon, Fielden's Hawk, the White-eyed Buzzard Eagle, etc. should not prove difficult to ascertain.

Common Pariah Kite (**Milvus migrans**).

This bird used to breed on the Secretariat and in small numbers in Lower Burma and curiously enough in November, a month or so after the great migration of non-breeding kites reaches Lower Burma. Any breeding records of kites in other parts of Burma are of interest.

Harriers (**Circus**).

As recorded in the *Journal,* I found a nest of the Pied Harrier (*C. melanoleucus*) with young ones in Myitkyina in May 1936 and any of these beautiful and conspicuous birds seen from mid-April onwards in suitable places should be carefully watched. I always imagined the very pale harriers I saw in the plains of Burma to be *C. macrourus,* the Pallid Harrier, but the only pale bird I ever secured turned out to be the first recorded Burmese specimen of the Hen Harrier, so sight identifications are *not* reliable!

Woodcock (**Scolopax rusticola**).

The records of woodcock in the plains and foothills of Burma, especially in the south, are very patchy (*vide J.,B.N.H.S.,* 15 August 1935, Note xx) and considering how much the bird is sought after by sportsmen and that it cannot easily be confused with any other, much more information is desirable. In the higher hills watch should be kept for woodcocks 'roding' at dusk, in March and April.

Snipe (**Gallinago**).

I commend to future naturalists the following:

(*a*) Mr. C. E. Milner, I.F.S., first noted that Pintail Snipe in Moulmein in early September were moulting their primaries and some could barely flutter. There are very few records of this, despite the thousands of pintail snipe shot annually before the war.

(*b*) What special food does the pintail snipe pick up on the grazing grounds after the rains and also in the dried *kaing*-grass, that it so often haunts, which makes its habitat so different from that of the fantail species?

(*c*) While the pintail begins to arrive in the first week in August, the fantail is normally a much later arrival and the dates are not properly on record.

(*d*) Records of very late snipe (e.g. in May) or of snipe drumming in Burma seem few and are not always well authenticated.

Pelicans (**Pelicanus**).

Though this unmistakable bird 'occurs' all over Burma, no one in the last 30-40 years has been able to say if, and where, it nests or when it migrates. The immense colonies which Oates found on the Sittang have disappeared. Have the Pelicans now retreated to the Dawnas, or the Upper Chindwin or the forests of the Malihka?

Large Cormorant (**Phalacrocorax carbo**).

Where in Burma does this very common bird breed at the present day and at what season? I have never seen a nest or heard of a colony. Oates found them breeding in the Sittang valley in October. In Myitkyina immense numbers can be seen *in full breeding plumage* in March and April.

Grey Heron (**Ardea cinerea**).

Here again is a very common bird in Burma, and yet I have only twice seen or heard of a heronry, once in Myingyan (Macdonald) and once at Kwingauk (Henzada) in February 1931. Oates never found it breeding and there are no records in the *Birds of Burma*.

Storks and Ibises.

The remarks made above about the grey heron apply equally to the following species, which are in many places almost as common, and which must nest *somewhere* in Burma.

White Ibis.
Glossy Ibis (Bred Myingyan 1906).
Black Ibis (do.)
White-necked Stork (do.)
Black-necked Stork (Bred Myingyan).
Painted Stork.
Open-Bill.

Burmese Francolin (**Francolinus pintadeanus phayrei**).

In Oates's day this bird was not known south of Prome. It certainly occurred in 1930 in Insein district, 30 miles north of Rangoon and also in Henzada. Its present range needs working out.

Moorhen (**Gallinula chloropus**).

Has bred in Shwebo and Myingyan. It may be a breeding-bird of the dry zone and should be looked for, as so few naturalists visit the great jheels at the height of the rains.

Coot (**Fulica atra**).

Not so far known to breed in Burma and again should be looked for as it is not uncommon in places.

Whiskered Tern (**Chlidonias leucopareia**).

A jheel-breeding tern which Stuart Baker found nesting in numbers in Assam. One would expect it also to nest in Burma in the rains but it has never yet been suspected.

Gull-billed Tern (**Gelochelidon nilotica**).

This large tern with a distinctive *black* bill is very common all over the stubble of the Sittang-Rangoon river plain. I feel sure it breeds somewhere on the coastline of the Martaban gulf but its nesting-ground has yet to be discovered.

Large Whistling Teal (**Dendrocygna fulva**).

What records there are suggest that this is mainly a dry zone bird (it is very rare in Manipur) and it is hoped that future naturalists will record where it is found at different seasons and whether it is or is not breeding.

Ducks.

It is hoped that sportsmen will preserve the wing of any ducks shot whose identity puzzles them. Between 1906 and 1936 the Scaup, Goldeneye, Smew and Mandarin Duck have all occurred in Upper Burma. There are very few records of the Common Pochard and Falcated Teal. Any true ducks found breeding in Burma in the rains should certainly be noted, and I hope one day that someone will run down the Pink-headed Duck (*Rhodonessa caryophyllacea*), recorded from near Mandalay and Bhamo between 1885 and 1908 but apparently not heard of since. In India it seems a bird of the *terai* country from Nepal to Manipur, haunting jheels in high grass, and is said to resemble the Red-crested Pochard on the wing.

If sportsmen would spend a little time reconnoitring a piece of water with fieldglasses instead of commencing to shoot as soon as they reach it, I think a number of ducks, e.g. the Mallard, would be found to be much less rare than they are often supposed to be.

Egrets (**Egretta**).

There are practically no records in the last thirty years to show the distribution of the two large Egrets, (*alba* and *intermedia*) in Burma, though probably both breed. *Alba* has no crest or breast-plumes in breeding plumage, *intermedia* is smaller with breast-plumes and no crest. The Little Egret (*garzetta*) has both. Any naturalist watching the larger egrets in the breeding-season should record the colours of the beak and orbital skin if they can be seen, as changes seem to take place about July.

PART II

Part I of this paper was written before I had seen the genial altercation which has recently taken place in the *Journal* between my friend Frank Kingdon Ward and Major B. E. Smythies. (vol. 44, p. 560 and vol. 45, p. 450). In it the first-named is prepared to wager that he 'could find 50 undescribed birds in North Burma', by which I think he means birds not mentioned in that comprehensive book. This bet he seems inclined to hedge in the latest number (vol. 46, p. 191).

Personally, were I lucky enough to return to Myitkyina district with a couple of years to spend on collecting, and a chance to visit not only the Sajyang area but also the Kumon range on the west of the district, I would be almost prepared to lay such a bet myself for the reasons given below.

Lord Cranbrook and Captain Kingdon Ward were in the Seinghku and Adung watersheds from the end of January to the end of October 1931. In that time they collected 152 skins, comprising 95 species of which no less than 30 were 'new to Burma' (*vide* Kinnear, *Birds of the Adung Valley,* Journal, Vol. 37, No. 2, 1934), which makes the collection a most remarkable achievement.

I myself collected at random for 3½ years in Myitkyina district, with the aid of several frontier officers and native collectors, my own collections being made within a mile of Government mule-tracks and nearly all below 10,000 feet. Of 472 species obtained, 39 or 40 species were 'new to Burma' and this takes no account of new geographical forms or subspecies. All but six of these species were seen and collected by me personally.

During the Vernay-Cutting expedition of 1938/39 (*Journal* vol. 42, 2 April 1941) five of us were collecting mainly in one small corner of the district from mid-November 1938 to early April 1939, i.e. 4½ months. We only spent three weeks, at a time of heavy snow, above 9,000 feet. Of 299 species obtained, I had not met 53 previously in any part of Burma and of 23 there were no previous records for the province. Three species were new to British India.

This gives a total of 92 species 'added to the list' of Burmese birds between 1931 and 1939 from one district, all because an unusual amount of attention was focussed on portions of an area of about 33,000 square miles (larger than Scotland). And yet anybody who compares the list of birds obtained by the late George Forest in Western Yunnan with those so far shot in Burma, and who realizes what a fraction of the area has been covered by collectors, will be prepared for more surprises, on the 'high tops' especially.

Any collector knows what a huge part luck plays in his work. Take the case of Ward's Trogon (*Pyrotrogon wardi*). It was first discovered in 1926 in the Seinghku Wang by Captain Kingdon Ward, whose eye for a rare bird is quite uncanny. For 13 years this remained the only specimen obtained in India or China, though Delacour found the same species in Tonkin in 1930. In 1938/39 we obtained five, all on the edge of roads in three different places, in a small area, part of which had been repeatedly traversed by collectors since 1919. Similarly two of the rarest birds in the Indian avifauna, the Wedge-billed Wren (*Sphenocichla roberti*) and Gould's Shortwing (*Brachypteryx stellatus*), were shot by my cook, Lazum Naw, when wandering out for half an hour within 150 yards of camp. Capt. Kingdon Ward obtained the very rare *Spelaeornis souliei* and the White-bellied Dipper similarly, when his mind was engrossed with botanical problems in 1939. At least 20 of this long list of species new to Burma are still represented by a single record or specimen, and there is no knowing when further records may come to hand, possibly not for fifty years.

On the other side of the picture, this semi-intensive work by a number of ornithologists in the last ten or fifteen years has shewn that some birds previously accounted as of extreme rarity, e.g. the Tibetan Siskin, the House Martins, the Yunnan Fulvetta and certain Thrushes, are by no means uncommon in parts of Burma.

Nothing is more remarkable than the way one can overlook even a noisy or a conspicuous species. Judging by the number of trapped birds brought in, the Peacock-pheasant must be fairly common in the lower hills of Myitkyina, and in the Pidaung game-sanctuary its note was always audible at dawn in spring. *Yet I have never to my knowledge flushed or set eyes on one alive.* It is the same with mammals. The hoolock gibbon, as everyone knows, is far more often heard than seen but it is a creature that draws attention to itself from miles away and is not easy to ignore. In 1939 the Vernay-Cutting expedition spent from 20th to 30th February at Hpimaw without suspecting the existence of hoolocks. They broke out into a derisive chorus of farewell just as I was leaving Hpimaw for good. For three and a half months, I spent hundreds of hours in the haunts of Temminck's tragopans, hoping to see or shoot one, with no success at all, and was rewarded by a momentary glimpse of two males on almost my last day.

I am afraid we still know mighty little and still, as I said in the *Ibis* eight years ago, have only 'guessed at the wealth of birdlife in Myitkyina by recording what comes to the surface of an enormous sea of some of the densest and least known jungle in the world'. In the huge areas of *Eupatorium* scrub, which cover so many thousand acres of the lower hills, in the almost equally difficult stunted cane which grows above 10,000 feet, and above all in the barbed-wire tangles of bramble which spring up after cultivation in the middle hills, there must be rare skulkers, finches, flycatchers, shortwings, bush-robins, pittas and bush-warblers, to name only a few, of which we know little or nothing. They are only obtained by a combination of great patience and good luck.

Yes, there are still great chances for the naturalist in Myitkyina. The late Captain Maxwell-West, an outstanding *shikari,* insisted that he had seen a 'red bear' near the snow line of the Chimili Pass where I saw bear-tracks and fox-tracks at 13,000 in 1939. The owls, the *Raptores,* most of the large pheasants and what I think was a chough eluded us all in 1939. In 1933 I saw at a few feet range what I believe may have been *Molpastes leucogenys* which occurs in Assam. In the Hukawng Valley someone should one day turn up the Swamp Partridge and two rare species of grass-warbler, so far not recorded east of Manipur and Cachar. One day too we may find the Upland Pipit on the Burma side of the Salween divide at high elevations.

Though much is taken, much abides.

We must not forget that it was not until just before the War that the Brown Rock-Pipit and the Siamese Bush-Lark were discovered in the dry zone of Burma by Mr. H. C. Smith. Their very existence in an open and easily accessible part of the province had been overlooked by everyone since Upper Burma was annexed. What more can any young naturalist desire than opportunities of this kind?

A BIRD PHOTOGRAPHER'S MUSINGS FROM KASHMIR.

BY

LT.-COL. B. T. PHILLIPS.

PART II.

(*Continued from* vol. 46, p. 103.)

On Jheel and Marshland

(*With 9 Plates*).

A visit to a jheel in Kashmir, immaterial whether it be large or small, produces volumes to interest a sportsman-naturalist. The grandeur of its mirrored scenery, the dense reed-beds, frigid or steamy according to season; and the toilsome marshy reaches are attractive and exhilarating. Finally the wealth of bird life affords unique opportunities of unravelling some new secret in nature still locked in obscurity.

The Dabchick, Purple Moorhen and White-eyed Pochard with a handful of mallard and coot, are perhaps the only residents on our jheel though throughout the year its bird life is abundant. During the shooting season duck of a dozen different varieties have been identified from bags made on it, while the marshy strips along its margin are favoured by the Common or Fantail snipe.

Rapacious harriers quarter the jheel, and undeterred by the fusillades of shikaris, swoop down into the reeds and play havoc with wounded birds, leaving but mangled mutilated messes for the eager beater to collect. Another nuisance raider, Pallas's Fishing Eagle, a fine large handsome dark brown bird, easily recognisable by its buff coloured head and neck, and the broad white band across the tail, proclaims its presence by its unmistakable raucous shriekings. It will be seen seated on some stump or mound along the margin of the jheel, or in hurried flight, endeavouring to snatch illegal booty carried away by a harrier; or swooping audaciously to carry off spoils from within reach of the sportsman's gun.

Beyond a small number of assorted waders, the visitors to the jheel, more commonly seen, belong to the fishing fraternity. The Night Heron, so shy and secretive by nature, is startled from its siesta in the dense reed beds; its larger cousin the Grey Heron, erect, motionless and seemingly asleep, makes its unerring dagger thrust to spear fish or frog unwarily encroaching in its preserves.

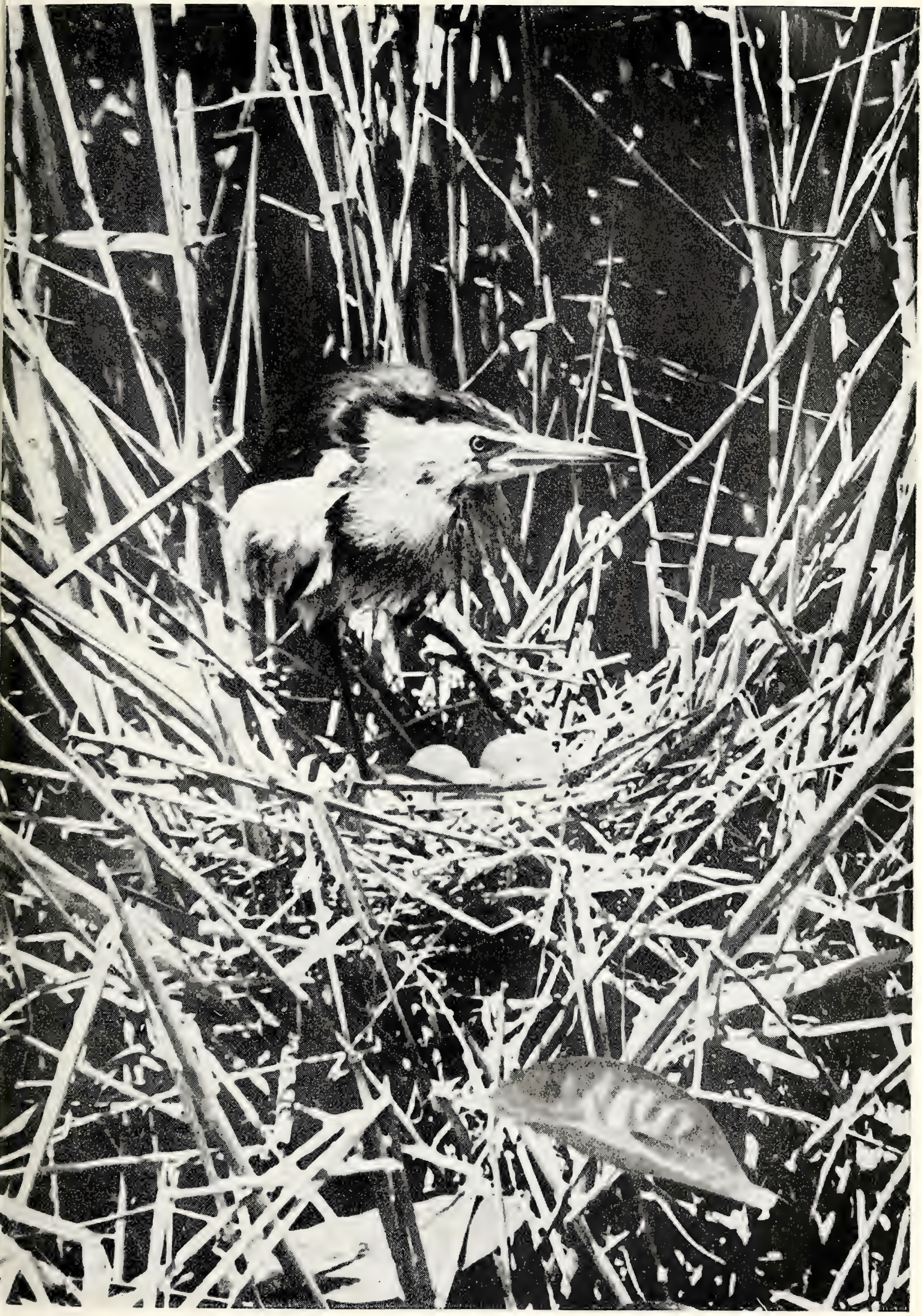
Before concluding this impression of winter bird life on our jheel, mention must be made of visits by the Large Indian Cormorant. Towards the commencement of the spring migration these birds are usually seen perched on some semi-submerged stump in the open basking in the sun, with wings extended, or perhaps busy preening their feathers. Six was the largest number seen on any given date. Their fluctuating numbers and total disappearance by the end of April gives ground for the assumption that this jheel is used as a 'jumping off' point by the birds on their passage to distant breeding grounds.

A bright frosty day in the depths of winter holds many charms Much of the sting of its biting cold is subdued by the heat generated by a *Kangri*, placed on the floor boards of the *shikara*. Or one may hold a *kangri* in ones hands sheltering under a 'tent d' abri' formed by a rug covering the shoulders and reaching down to the floor of the canoe. This *kangri* it must be explained is an earthenware pot filled with a handful of live charcoal, copiously covered with ashes. It is the local form of heater; needs no attention and gives out welcome heat for hours on end.

Seated in this fashion, a start is made for the butt in the middle of the jheel which serves as a 'hide' to watch duck. Often the *shikara* has to be forced through a thick coating of ice, a man in the bows deftly cracking a passage with blows from his paddle. The uninitiated passenger has uncomfortable visions of possible disaster and considers what immediate action may become necessary should his frail bark founder. The boat's constant tussle with the sharp and jagged pieces of ice paint a menacing picture. Fortunately tragedies are few, and so not worthy of worry. Soon the open deep water is reached. Roosting duck and teal rise in a mass with a great clatter of wings. They circle round and gaining height, the various species forming separate parties, head away for quieter waters. There is no need for anxiety. Other parties of varying strength will drop in from the skies throughout the day, affording fine pictures to the concealed watcher as they float towards him, many with bills tucked away under wing, sound asleep. Drakes of the stately mallard, the streamlined pintail, the rare and immaculate Smew cheek by jowl with that curiosity the Stiff-tailed Duck, with its conical blue bill, are all represented. The tireless, plump, bob-tailed Dabchicks see to it that this concourse of duck does not fall into a deep slumber. They are kept constantly on the *qui vive* by disturbances caused by these playful birds. The game is a version of our 'hide and seek'. One bird, surfacing behind a sleeping duck in attempt at concealment is spotted by the other, who immediately, with a sharp trilling cry, gives chase, pattering along the surface of the water, half running, half swimming. The game continues *ad nauseam* all over the area. Like the Dabchick, the Coot is also a member of this mixed assembly. But they are placid birds, somewhat reluctant to fly, and not quite such a nuisance during the traditional hour of siesta.

As the shadows lengthen, the birds become distinctly restless as if awaiting a signal. Suddenly, with bewildering whir of wings, the whole community is in flight. It is the answer to the urge of yet another lifelong custom: the evening flight to their feeding grounds.

During the spring migration, April is an outstanding month for the bird-lover. At this time, Kashmir becomes an important



The Little Bittern.

pied-a-terre for a countless multitude of bird migrants. Summer visitors overlap belated winter ones, these again in their turn are augmented by a host of passage migrants from India breaking journey on their way through to the Far North. Bird life overcrowds the countryside and Kashmir's avian population is brought to its peak. Most of the lakes and jheels afford safe retreats and temporary rendezvous for these throngs. Yet even to this day, it can be asserted that the Wular Lake and its environments hold much of interest to the expert collector. There is every chance that some new species or some bird previously unknown to nest in this land, may be brought to the bag. To the uninitiated, bird-life at this season holds endless thrills. The galaxy of birds in full nuptial plumage becomes a kaleidoscopic pageant. Their song, though not as yet at full pitch, is pleasing to the ear. The waking world, with its verdant flower-studded landscape, soon helps to brush aside the dull monotony of silent and colourless winter.

April gives birth to a season of joy, to a promise of good hunting to all wanderers in nature's wilds.

For those who know Kashmir only as a luxurious playground, a warning—these outings are not made in one of those romantically trimmed, spring-seated *shikaras* of the Whoopee class—but in one much more spartan in type, uncanopied and hard to the touch. In spite of this, when wending ones way to a rendezvous, one gasps, at the surpassing loveliness of the scenery on this sequestered jheel, cut off from the hum of human bustle and surrounded by imposing mountains, snow-capped at this time of the year. The impelling beauty of the scene holds one's whole attention. The *shikara* is poled at first along a narrow passage cut through the dense reeds which cloth the margin of the jheel, but even from the lowly view-point, when the open water is reached, one is struck by the vivid and crystal-clear reflections thrown up from the limpid surface. The snow-capped mountains, the graceful clusters of willow trees and the border of dense reed beds are mirrored in minute detail. Further glory is added to the scene as the sun approaches the horizon and sunset tints add lustre to its loveliness. But there are unsought and distracting influences which mar one's enjoyment. The torment of flies by day is now replaced by the buzzings and bites from hordes of hungry gnats and mosquitoes, and should it become necessary to forage about a neighbouring marshy strip—beware of a particularly obnoxious 'jheel itch'—an unbearably irritating rash that sets the legs afire. The inflamation is apparently caused by the bites of myriads of microscopic organisms which shelter in the mud and slime of a rice field. Though warned by my shikari, the chance of getting a good series of pictures of Hodgson's Yellow-headed Wagtail, which chooses the banks dividing these fields for a nesting site, was too good to be missed. Besides his assumption that a 'two bath a day' wallah was just as prone to this infection as the great unwashed local, demanded correction. I paid no heed to his warning.

I soon discovered that it does not pay to shun local advice, the intolerable 'jheel itch' flared up that very evening and life became a burden for three long days. Yet my shikari was all sympathy, and never by look or sign did he suggest an expected and infuriating 'I told you so'. Luckily it did not take long to discover an antidote. When questioned, the ryot explained that what looked like undiluted dirt caked over his legs was really the stain made by the application of a viscid fluid extracted from burning pine logs. It is used by the natives as a precaution against 'jheel itch' so prevalent in these marshes. Assuming this concoction to be some crude resinous extract, an ointment made up of a mixture of vaseline and essence of coal tar in the proportion of one teaspoonful of essence to one ounce of vaseline, was tried. It was found to be efficacious, and so this last but not least of 'horrors' was checked.

The present economic stress due directly or indirectly to the World War has made its mark even on birdland. Soaring prices of the mere necessities of life have forced the local inhabitant to go yet farther afield for materials used in local cottage industries. To meet the increased demand for such commodities partly attributable to the phenomenal influx of visitors to Kashmir, many of nature's strongholds, previously untapped, are now ruthlessly exploited to the detriment of bird life. For example on jheels, reed-beds are denuded for mat-making, grasses of all species for fodder; even submerged weeds are dragged up to serve as foundations for more floating gardens to supply a sufficiency of vegetables for the market. These activities are in full swing and coincide with the height of the breeding season when most birds are busy completing their fresh clutches.

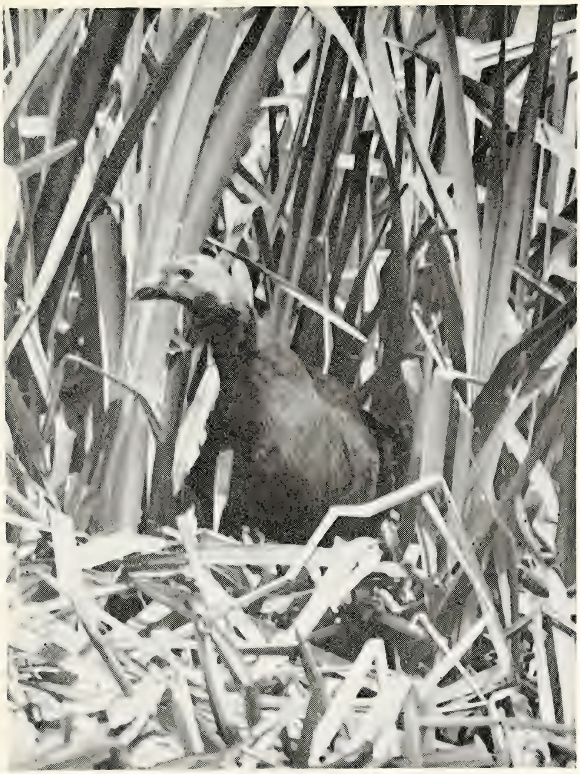
As the eggs of most water birds are considered a delicacy in the villages, the impoverished local, to whom nothing is naturally negligible, adds destruction in the wake of his grass cutting.

One is apt to forget that the animal world stands subservient to human needs, and so, when ensconced anxiously awaiting the quarry, one is apt to inveigh against a clamorous phalanx of reapers, slowly advancing, sickle in hand, denuding cover and destroying all that comes within reach. An ordeal not to be left out of reckoning during outings in May and June.

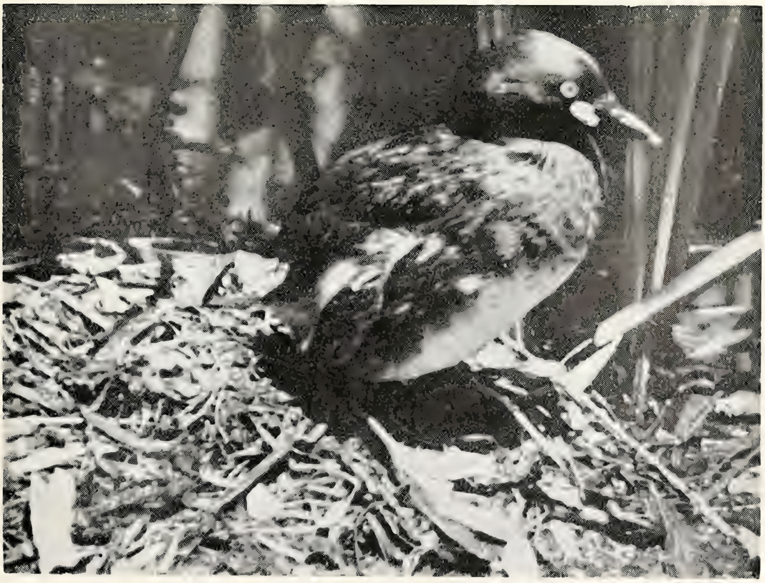
The bird Photographer's lot in the main necessitates hour on hour of patient watching, often, under trying conditions. The scorching sun, the stifling atmosphere inside the reed-bed—his temporary retreat—the infuriating flies and hordes of voracious mosquitoes are the constant discomforts falling to his lot on jheel or marsh.

The 'Hide method' of bird photography demands even greater personal discomfort from its disciples. One is couped up in a miniature tent which denies even the occasional zephyrs that bring relief to the man in the reed-bed. Further the restricted view obtainable through the peepholes, must tend in the long run to develop tired eyes and a likely squint for the rest of ones days.

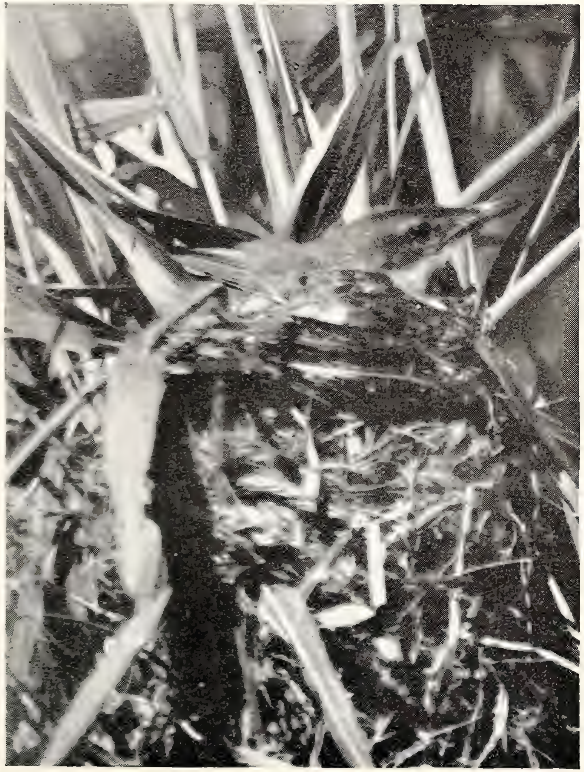
To the naturalist however, there are many compensations to outweigh these hardships. Birds classed as 'inveterate skulkers' emerge before the eye at the closest of ranges uttering their grunts and groans, and fearlessly courting some seemingly disinterested



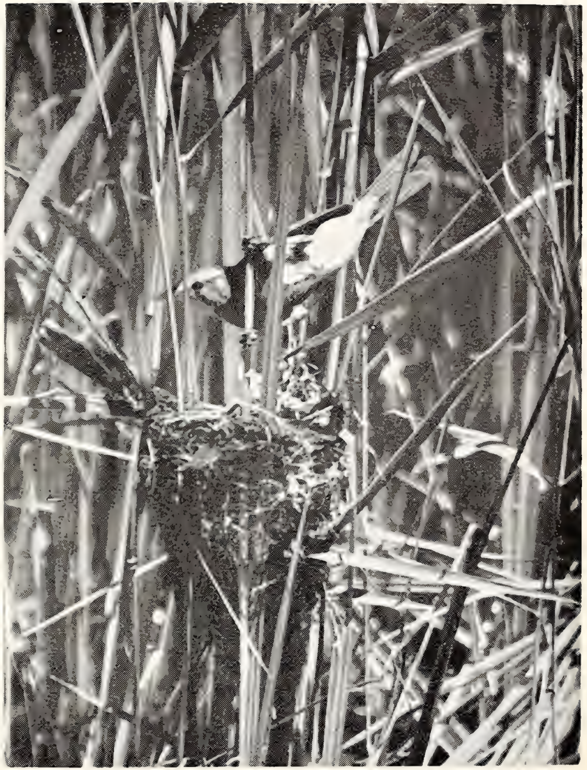
The Purple Moorhen.



The Dabchick.



The Indian Great Reed Warbler.



The Kashmir Paddy-Field Warbler.

mate. A pretty picture was made by a pair of those arch skulkers the Water Rail. It is a bird that can seldom be beaten out of its known haunts in the dense reed-beds or for that matter, even seen. Yet on the undisturbed, restricted playground, within a yard of my vantage point, it became evident that cooing doves did not surpass the love-making of this Rail, utter though it does the most discordant of mating calls. It was surprising to find that this small bird, a little over a foot in length, was responsible for such an amazing volume of sound which resembles, for want for a better simile, the noise made by the rumblings of an elephant's tummy: startling sound indeed in such solitudes. The strident metallic calls of the Great Indian Reed Warber uttered with persistance and vehemence and from every direction usually jars the nerves as the temperature rises. But as I have said the reed-bed offers its compensations. Imagine my surprise when I discovered that the Warbler proclaiming its presence from a perch within a foot of my head was an albino. Its whole plumage was a creamy white except for the faintest suggestion of its normal markings. Its salmon-red mouth and pinkish straw-coloured legs added tone to this fancy dress.

It neither appeared to be harried nor accompanied by any of its kind during its solitary flights from bed to bed throughout the day. I did not see it again during subsequent visits to the jheel.

There is always something of interest to attract attention throughout the long hours. A Bluethroat, a passage migrant to the Vale, sits and preens its plumage within arms length. That little jewel, the Common Kingfisher, exhibits the ease with which it swallows silvery fish; the dainty Whiskered Tern, with the accustomed grace of terns on the wing displays its purposeful, rythmic flight and the delicacy with which it picks its food from off the water or weeds. These are but a few examples of interest among a host of visual delights to be encountered throughout the day.

The birds of the marshes are a noisy community, their loud cacklings, grunts and hoarse rippling notes beggar descriptions; hardly a pleasing note can be picked up from this constant chorus of discords.

Every day from early May till late July there need be no dull moment for the bird-watcher from the time he sets foot in the *shikara* until his return to the shore. Birds in great variety are numerous and busily engaged in all the activities connected with breeding. The bustle, the exuberance of flight and emotional song reflect the spirit of the time and the joy of living.

In the following descriptions, species are not given scientific priority, but are grouped together in accordance with the surroundings in which their nests may be found:—in dense reed-bed, over open lily-covered water, in treacherous bog and marsh, or on the drier, less waterlogged reaches, clothed in a lighter type of reed, which borders marsh and paddy-field.

Although nests of the Mallard and White-eyed Pochard were frequently found, I did not risk disturbing them by my photography. It is hoped though to try conclusions with the Coot and

Common Snipe during the coming spring and summer, and thus complete a record of pictures of all the water birds known to breed on the jheels and contiguous marshlands in the Vale of Kashmir.

The Indian Little Grebe or Dabchick. *Podiceps ruficollis capensis.*

I have chosen the Little Grebe as my first subject, as it was the first water-bird to face the camera.

While the *shikara* was still in the distance the sitting Dabchick was seen to plunge into the water from the nest, but not before she had found time with a deft movement of the bill to cover up her clutch of eight dirty white eggs. All that was to be seen was an untidy mass of damp water-weed, half submerged and resembling stray drift accidently hitched up to the tufts of growing marsh stalks. A nest easily overlooked by unschooled eyes.

No drill had been evolved, the setting up of the apparatus took time; but when finally my viewpoint was reached, there was but a half hour's wait before the bird waddled up onto its platform nest. The act of uncovering its eggs was too much to miss, and so, the golden rule—never disturb a bird on its first appearance at the nest until it has comfortably settled down for a minimum period of half an hour—went by the board. As was anticipated, the click of the shutter caused a hasty dive, but again, not until the eggs had been covered. There followed a long wait before a further exposure could be made. In the meantime one could almost understand the jargon expressed in long drawn out descending trills as she passed the news of the disturbance on to her mate. It was quite an hour and a half before the male convinced his frightened spouse that she was unnecessarily alarmed. Eventually, by example and look he induced her to waddle on to the nest alongside him; indeed a reward for patience, for the shutter truly recorded this intimate scene. Now followed another tedious wait before their next return to the nest. When they did, one bird was seen to rush at the nest with wet weed in the bill, this was deposited, and further the nest was splashed with water, while the mean hen, afloat on the other side, made a rippleless dive and appeared again by the side of the male and screwing up courage once again waddled on to the nest. This final picture of her look of sheer boredom as she balanced herself on her curiously lobed feet was considered a sufficient reward for the long hours spent in the heat, and so the birds were left in peace to carry on the good work.

Another item of interest presented itself when the site was passed a couple of days later. A newly hatched chick was seen to splash off the nest into the water, and as to the manner born, swim away to the shelter of a bed of reeds, tweet-tweeting as it went.

In no illustration or description of the Dabchick in the current Indian bird books is mention made of the ivory-coloured, rosette-shaped wattles that grow on the cheeks at the base of the bill. These are regular adornments in breeding plumage.

The Purple moorhen. *Porphyrio poliocephalus.*

The Purple Moorhen together with its smaller cousin, the Moorhen, are among the most wily of fowl anywhere within the nesting area. The former only allowed six exposures to be made during 36 hours of sittings spread over a period of six days. Two shots in colour included in this small bag, failed to materialize in the processing. The Moorhen shows a record even blacker, for that bird evaded the camera entirely during sittings aggregating ten hours. It must however be admitted that although these birds are guaranteed to try the patience of Job nevertheless they form subjects well worthy of effort by Job's younger brother, the bird photographer.

Although success with the camera was meagre with *Porphyrio*, yet the wealth of knowledge gained of its habits well outweighed hardships and discomforts.

The identity of this bird, about the size of a local hen, is unmistakable. It has long ungainly red legs, a heavy red bill terminating in a frontal casque across the crown, a bizarre acoutrement which somewhat mars the beauty of its handsome purple blue-green plumage.

During my reconnaissance trip to the jheel, while moving along the narrow waterways cutting into the dense reed-beds, many platforms were seen near the water's edge. These, I was assured, were made by the birds themselves, who sheared off stalks, some two feet above water level and entwining the cut off portions make a solid circular platform which is used for sunbathing, feeding, etc. The nest was invariably in such a position. Twisted blades of marsh grasses line the depression which take the eggs.

By the discovery of four of these nests in April C.6, C.5, C.5, C.4 and one in July C.5, it can now be stated that the Purple Moorhen breeds in Kashmir. The finding of the April nests on the 18th of the month came as a surprise, as the last duck shoot of the season took place on the 12th at a time when the nests were just completed, and the first egg at least laid in a couple of these. One nest was not more than 70 yards from the butt. The eggs are a larger edition of those of the Moorhen, spotted and blotched with shades of brown over a reddish-stone ground colour. The C.4 mentioned above contained a freak set of four pure white eggs, without blotch or speckle. The C.6 nest provided an interesting record, the sixth egg was laid in it on April 18th, the chicks commencing to hatch out on May 10th. All the nests found were in comparatively shallow water, and although a depth of eight feet was the most to contend with, it was often a struggle to find the bed of the jheel owing to a semisolid boggy obstruction that intervened. A sudden unexpected break through has been the cause of many a good ducking to the perilously poised sportsman in the bows of the *shikara*—a merry making picture to the spectator, but often implying the loss of camera accessories to the careless photographer.

The tale of my endeavours at photographing the Purple Coot is a tale of discomfort, aggravation and comparative failure. From my vantage point in the mosquito-ridden reeds, the birds could be seen or heard throughout the long vigils. Would either of them come into the focused area?—No; they were as though on 'Sentry go' patrolling the precincts, sedately picking their way along stray floating reeds, or awkwardly clambering up, hand over hand, to the top of the bed to gain a better view of the surrounding country. Their calls and cackles gave away their position throughout the long hours. Exasperated by these tantalizing tactics, I could not suppress my feelings any longer, and proclaimed my presence in plain speaking. The answer to my tirade from the nearest bird was both interesting and amusing. It stood its ground and with body drawn up to full height, clapped its wings with resounding cracks above its back, hooting a succession of hoarse expletives. Then it stalked off in its stilted way, flicking its tiny triangular tail in true waterhen fashion. Its loud chuckles as it disappeared into the safety of the reed beds made me feel that the bird had indeed won the first round.

My anxiety for the safe hatching of these eggs, often prompted me to end the uneven contest, but having been goaded into stubbornness by the seeming indifference shown by the birds for their eggs, I decided that even should may day-long sittings eventually addle the eggs, I would stick to my post until such time as the birds themselves deserted the nest. My shikari affiirmed that the Moorhen were not in the habit of brooding during daylight, leaving incubation to the hot rays of the sun. He further stated that the birds had often been seen taking up their duties at sunset over the apparently deserted nest, and not leaving it until the sunrays had gained strength in the morning. After my experiences, I favour this view; my day-long sessions at the nest did not interfere with the hatching out of the complete clutch.

After many fruitless hours of waiting I resorted to stratagem and thereby met with a certain amount of success. A horse-shoe shaped clearing, two feet wide was made, the nest resting midway between its two heels. All weeds were plucked up by their roots leaving a stretch of open water, except for a weedy causeway which was left undisturbed. This causeway was the normal runway used by the bird on its way to and from the nest. It was anticipated, that being lothe to fly, a skulker and an expert at threading its way through the dense reeds, the bird must eventually use the only land route in the nesting area. The resultant four pictures taken, depicts the bird in varying attitudes of unhurried movement.

My final day's outing on May 10th was, photographically speaking, in keeping with the succession of failures usually experienced in my pursuit of these birds. The bubble, that my 'horse-shoe' trick would ensure success, burst. The sound of a soft tweet from the reeds near the nest told its own tale, but imagine my delight on reaching the nest to find one chick struggling to release the remaining portion of the shell from its nether regions, while another, with tiny beak protruding from the shell, was doing the like. The first chick, an all-black ball of fluff with tiny red legs and red patch on forehead, looked up and, either in answer to a soft tweet from its twin, already hidden in the reeds, or because the sun rays were uncomfortable, hobbled off to the edge of the nest, and hand over hand made for the shade, where it, in its turn, sat tweeting.

The Little Bittern. *Ixobrychus minuta.*

The Little Bittern is a minature heron, about the size of a partridge but with longer legs, greenish yellow in colour. The male bird is clothed in buff and black, the black portions changing to brown in the female. The bird gave very little trouble and posed freely before the camera. Though common in Kashmir in summer, they are seldom seen by day as they prefer the seclusion of the dense reed beds then. It is not until just before nightfall that they sally forth in numbers to take up the fishing stations in the shallow waters.

I was lucky in finding some that discarded these rules. One allowed my *shikara* to creep within photographic range and take a picture of it. Aroused by the click of the shutter, position No. 2, that of alarm, was assumed. In this position the bird brings into play the markings provided by Nature. The brown streaks along its thin long neck, now stretched taut with bill pointing to the sky, assimilate with the lined back-ground of reeds and obliterate the bird.

The nest is a shallow pad of grasses built in dense reed beds, or occasionally in a convenient fork of a semi-submerged willow tree, always near water level. Six to eight white eggs form the clutch. The nest chosen by me for operations was placed in a dense reed bed, standing in stagnant water, thigh deep.

The bird's glide—no other word describes its easy progress through the reeds—is truly remarkable.

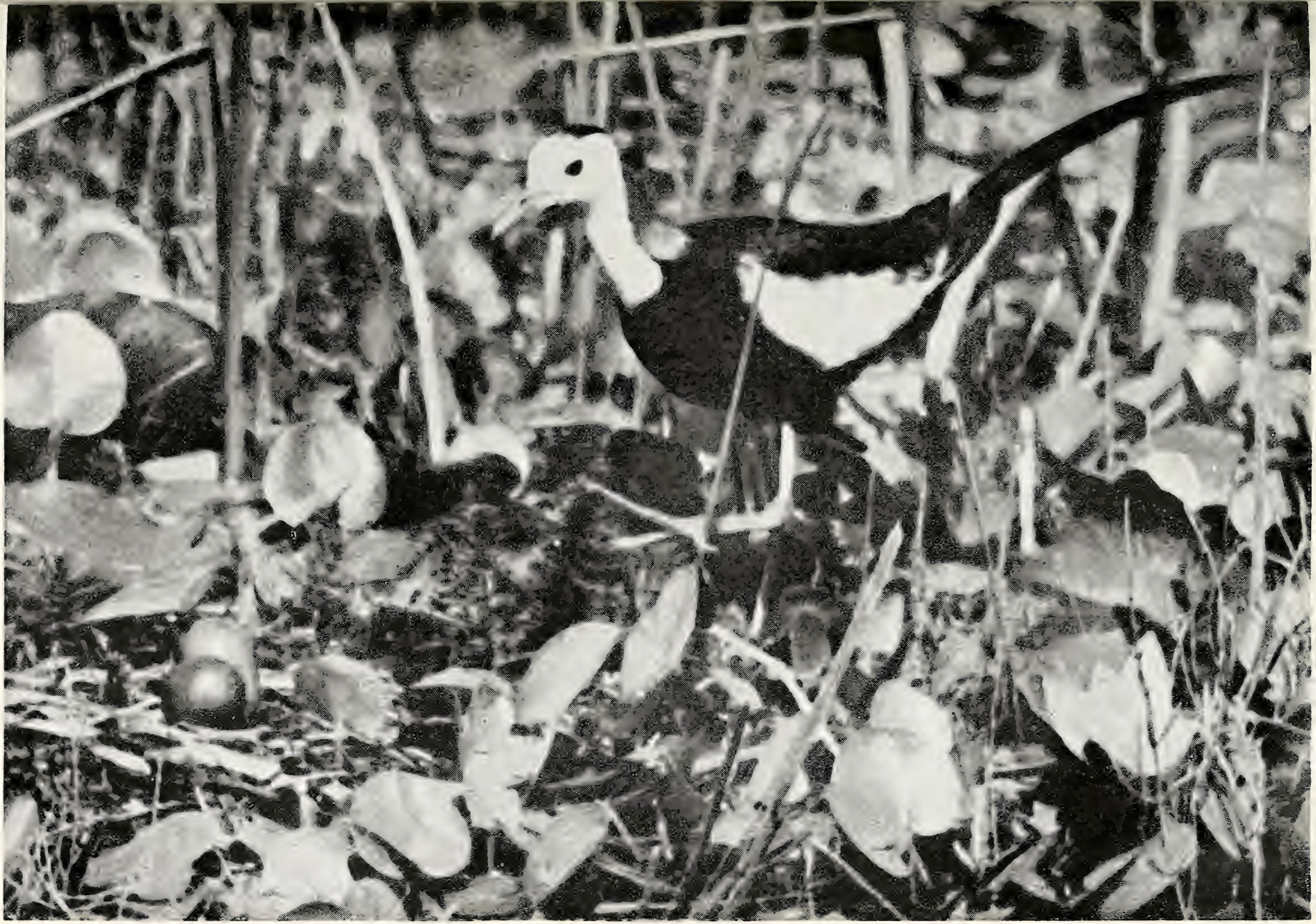
The Indian Great Reed Warbler. *Acrocephalus stentoreus brunnescens.*

It is impossible to distinguish in the field between the numerous members of the large Warbler family, which contains a host of small brown birds without distinctive features. This Reed Warbler is an exception owing to its giant size. It is a little smaller than a Bulbul, its large bill and the rich salmon red mouth are seen if at close quarters, throughout the day as it gapes to deliver its unceasing metallic call. Its notes full of volume and exuberance are distinctive. Its Kashmir name *'Kak Karra Choo'* is a good imitation of a favourite stanza running through many other harsh squawks. I look upon him as a coarse fellow, in a family of fine cheery small people.

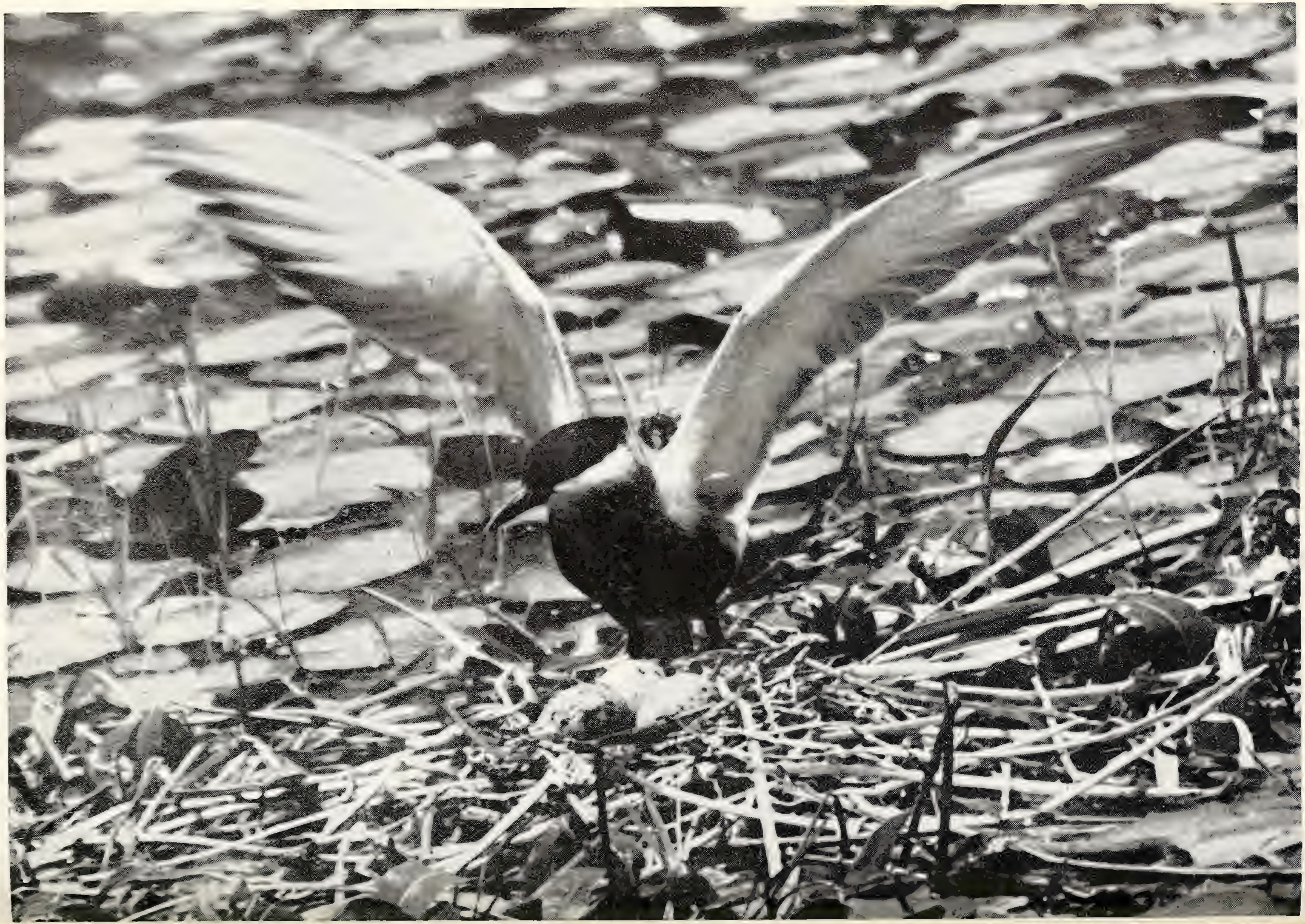
The bird is extremely common in summer. Its harsh notes betray its presence in every reed-bed in which it moves about with much skill. The bird is not a skulker in its literal sense. Often, at this season, it may be seen continuing its harangue from the reed tops unconcerned at the presence of a human within arm's length. Nor is it shy on its nesting ground and will allow a close approach.

Nests are ubiquitous and take the form of a massive, deep, cup-shaped affair, made of coarse grass but comfortably lined with finer grasses. They are suspended between reeds and stalks and attached to three or four of them about a couple of feet or so above water level. The clutch consists of four or occasionally five greenish eggs. These are speckled and clouded, mostly at the broad end.

Efforts to picture this bird do not present many difficulties. During my first attempt, the bird returned to its nest while I was still erecting the easily handled water-bird apparatus. But it must be admitted that it was slightly disturbed when I overbalanced and took a header into the water losing a valuable exposure meter in the process. It was not quite clear to me whether the squawks from the bird in the depths of the reeds meant to convey concern or laughter at the episode. Be that as it may, I soon finished off the successful morning's work by exposing a whole roll by hand, meeting no further inconvenience.



The Pheasant-Tailed Jacana.



Owing to its jerky mode of climbing up to the stalks and the rapidity with which it settles down in the nest, it is difficult to get a good picture of the bird unhidden by the stalk it is gripping, or when hidden in its deep nest.

The Whiskered Tern. *Chlidonias leucopareia indica.*

A flock of dainty streamlined Terns flight, are intent on hunting. They advance across the lily-strewn waters of a jheel with bill and eye directed downwards. Individuals break away incessantly to dip down with graceful swoop to seize prey from off the water or weed. It is a sight for the gods, and one common to Kashmir throughout the summer.

This marsh Tern, being the only representative of its family in Kashmir is easily recognised, as in both sexes, the black cap and general silvery effect of the plumage is distinctive.

Many delightful incidents can be witnessed when watching terns at the commencement of the breeding season. One, very common at this season is a bird in full flight dipping without hesitation to the surface of the water to seize a lily stem in its bill and carry it off to the nest. While watching a ternery, an intruder in a *shikara* once approached the colony. In an instant every tern took to wing and pandemonium reigned during their menacing attack on him. This was the moment chosen by a lazy 'blackleg' to pick up material from off one of the deserted nests. It saved itself the trouble of flying to the far end of the jheel where suitable stems were abundant. Result: the overturning of the temporarily deserted nest and the loss of its eggs. The marauder unconcerned flew off to his own nesting site to deposit the ill-gotten gain. This manoeuvre has actually been witnessed by me on three occasions.

The fluffy little ternlets in their buff-splashed black clothing present a pretty picture. When alarmed they instantly skedaddle from the nest and take cover among the lily leaves, often with only bill protruding above the water.

From a photographic standpoint, the bird provides a problem owing to the open site of its nest, which is usually over deep water. There is always the risk, that the nest will be found rifled. Absence of legislation to curb the tempting demands from epicures for 'Plovers eggs' has turned these eggs into a valuable asset, easily obtained by the poor local inhabitant. It is a pitiable sight, to find a breeding colony of perhaps fifty nests or more which had been agog with excitement and graceful activity on the previous evening, lying entirely deserted the following morning. All the nests, those platforms of lily trailers, carelessly interlocked and supported by weed or lily stems, were empty, ruthlessly pillaged of their one, two or three bluish speckled eggs.

The Pheasant-Tailed Jaçana. *Hydrophasianus chirurgus.*

After paddling through the willows and reed-beds lining the margins of most jheels and reaching stretches of open water, the author of those mysterious cat-like mewings heard at intervals in the distance is seen. These black and white birds, a large edition of a pigeon, prefer stretches of open water, where the lilies and other water plants grow in great profusion. The distinguishing features of this Jacana are a long thin black pheasant tail, and a rich golden yellow covering to the back of the neck. The ease with which the bird can move over floating leaves is due to its disproportionately long toes and claws.

The Pheasant-tailed Jacana is fairly common in such places, and nests are not difficult to find in June. Most nests found by me were built over deep water and were structures of the flimsiest type—a few twigs or lotus stems resting on the surface of the water. One clutch in particular containing the usual four pegtopped glossy bronze-coloured eggs, appeared to cheat the laws of gravity entirely by resting securely on a layer of green vegetable scum. Though the birds are not shy around the nesting area, the deep water and open surroundings make the taking of a set of pictures a task that requires time. The two or three series were taken over an average depth of 12 feet of water and without a stitch of cover for hundreds of yards.

I shall never forget the day when a half hour sufficed to take all the snapshots required. The nest happened to be on a beat frequently used by jackdaws on their busy foragings to and fro. As is their wont while in flight, the jackdaws give out a call which sounds like 'Jack'. This cry is treated by the Jacana with much respect. On hearing it, the owner of the nest, regardless of possible danger from the camera, rushed to her nest and stood guarding the eggs, feathers ruffled and wings quivering with excitement. The frequent comings and goings of these jackdaw were instrumental in giving me some of the best action pictures in my collection. Unfortunately none are available to illustrate this article as Dufaycolor films were in use that day. The jackdaw is 'arch marauder of the marshes' but as such, becomes a trusty aid to the gradually melting photographer. I could cite many instances to show that all brooding birds have a horror of jackdaws, not because of possible bodily injury to themselves, but because of their uncanny ability in searching out nests and playing havoc with the eggs during any short absence of the parent birds.

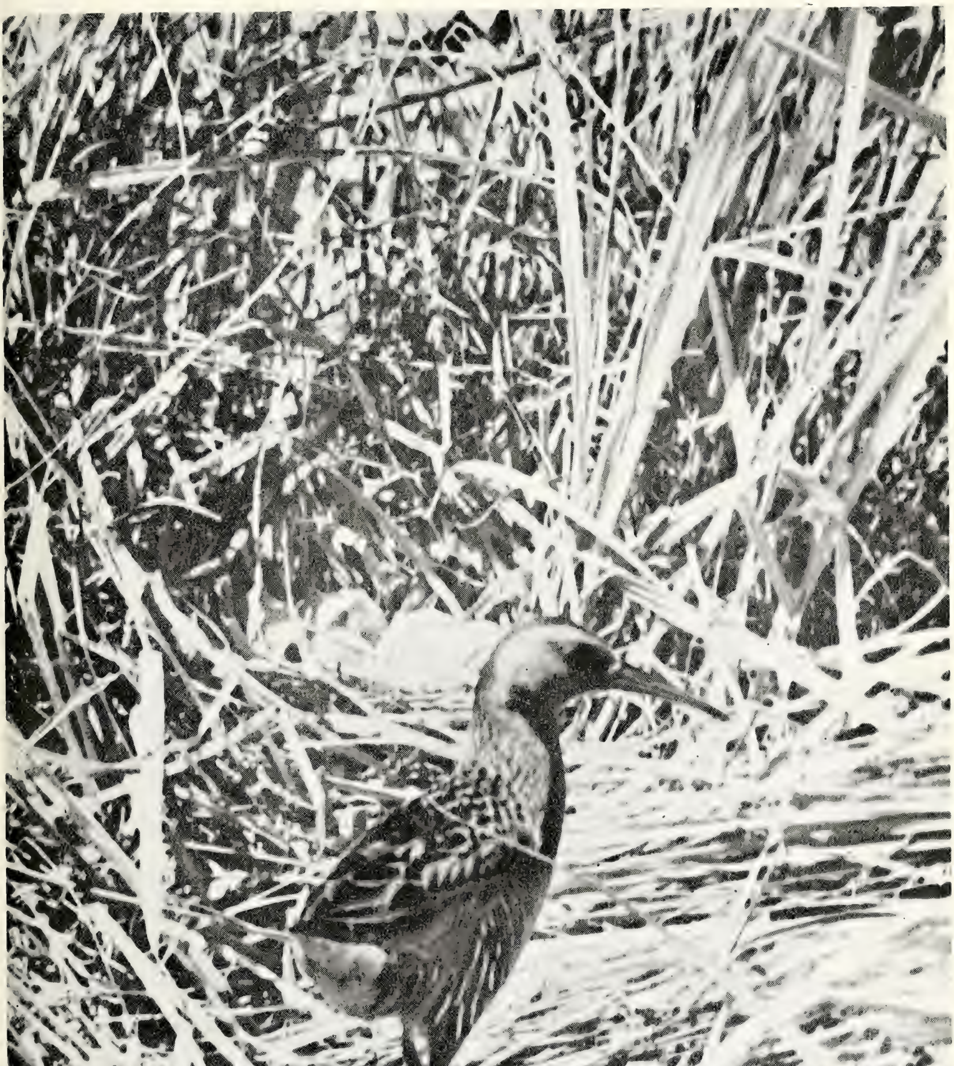
My vantage point gave an extensive view of the countryside in general and although both Stilts were in the vicinity of the nest, they appeared reluctant to walk into the focused area, until the magic sound 'Jack' was heard in the distance. The reaction to it was instantaneous. The mother bird rushed to her nest, while her mate rose with noisy cries to intercept and attack the approaching marauder. The jackdaw, managed tc keep out of reach of the Stilts' pointed beak. The action was soon broken off, the Stilt returning to his marsh, while the jackdaw circled round and made for a Chenar tree on the distant shore of the lake, the direction from which he had orginally come. Now comes the pith of the story. Within five minutes, the incident was repeated, the 'Jack' once again coming from the same direction. Two jackdaws were in the air this time, one flying fifty yards in the rear, and as the Stilt was about to overtake the leader, the second jackdaw closed in and tweeked the extremites of the long red legs, projecting helplessly some six or seven inches beyond the Stilt's tail. The Stilt dropped to earth with a shriek of alarm. The equivalent of a chuckle, uttered by the jackdaws as they approached one another and circled back to the Chenar tree, savoured very much of collusion. I leave it to the reader to draw his own conclusions and decide whether these birds showed a marked degree of intelligence or not, and whether instances like this should not give food for further serious consideration by scientists, interested in such facts, to amend their previous findings and allow to certain birds the power of thought and subtle reasoning.

The Black-Winged Stilt. *Himantopus himantopus.*

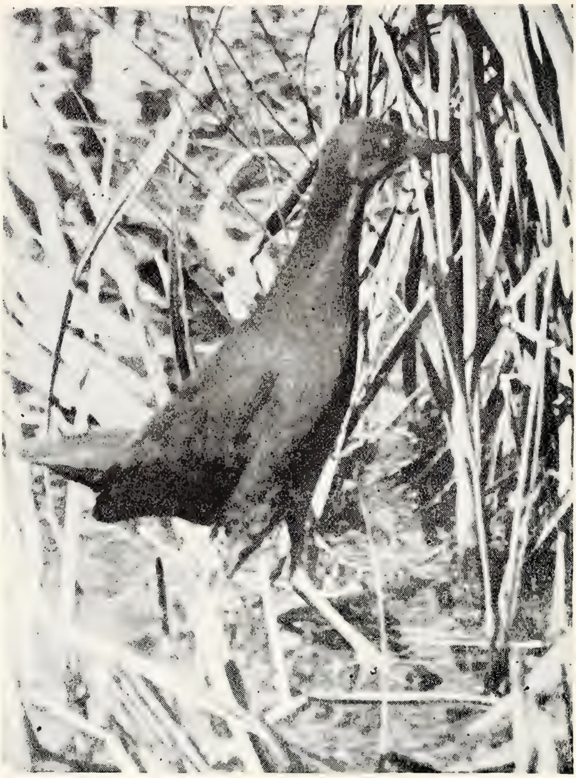
The Stilt is about the size of a partridge but with body streamlined. The long slender black bill, lanky red legs, quite 10" in length, together with its pied plumage makes identification unmistakeable.

While bird watching in the month of March down in the Bombay Presidency, a common sight was a gathering of many species of waders rummaging in a marshy strip along the water's edge. Conspicious among them was the Black-winged Stilt. Their long legs, enabled the handful of these birds present, to feed in unhustled comfort, tapping a food supply not available to the others. It is a long cry from that venue to the Kashmir marshes, where I was extremely lucky in finding a solitary nesting pair and getting a good set of photographs. The birds are very scarce here, in fact, no more have even been seen since by me. The rare spectacle of a Stilt flying overhead drew me to the area where it had pitched into a muddy dyke. A quartering of this area through binoculars not only showed me the Stilts but a pair in the process of changing duty at the nest. The joy of this discovery was much damped. A grass cutting party of Kashmiris was slowly approaching the site and not more than one hundred yards distant, cutting as they came. In spite of a strong dose of that universal Eastern remedy 'Bakhshish' being handed out, a restless night ensued broken by dreams of the certain destruction of such a rare nest. However on arrival on the scene next morning all was found in order and the day, though one of the most tiring, proved to be a wonder day.

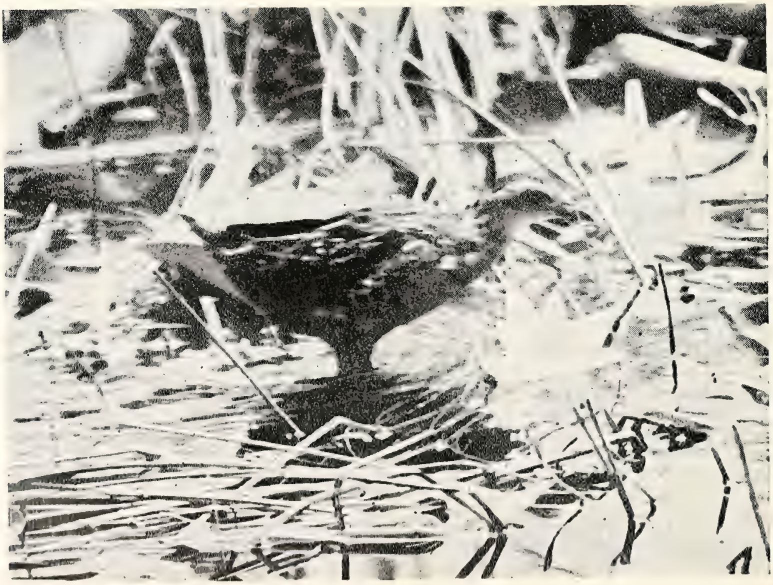
As my small party approached the nesting site, the birds became agitated and rising from the marsh with shrill pipings, mobbed us. It did not take long to get the camera apparatus ready for the fray. Little did I realise the ordeal ahead as I briskly stepped off the firm ground on to the spongy bog. A few paces sufficed to cause the loss of both my shoes stripped off in my



The Turkestan Water-Rail.



The Northern Ruddy Crake.



The Eastern Baillon's Crake.

efforts to drag out my legs, held firmly and deep in the glutinous mud. Much exertion was required to make the ten yards separating nest from bank.

A few lily stems carelessly strewn over a patch of green scum on the surface of the bog were the only means of support for both eggs and bird. How such a load does not sink is a mystery. The eggs were large, of a stone colour and heavily blotched with shades of brown, and totalled three in number.

The Painted Snipe. *Rostratula benghalensis.*

The stumpy long billed bird, the size of the Common Snipe, presents a colourful picture with its brightly barred and oval spotted markings. The buff band along crown, the spectacles together with the buff band of same width down each side of the back and joined to the gorget, divides the upper plumage, from the beautiful wings and tail which are of bright metallic olive green patterned with bars of black and conspiciously spotted with buff. The white under plumage completes the very pleasing picture given by the birds. The male is more drab than the female.

The male bird is smaller in size and less showy than the female and by his constantly lowered head and shame-faced gait tells a tale of oppression and uncomplaining endurance. This conduct is obviously attributable to the overpowering demeanour of the female of the species. Some kink in nature has made her the dominating partner in all matters sexual, and further, conferred on her the habit of polyandry. It seemed *infra dig* to be witness at a scene where three females challenged each other and fiercely contested the privilege of taking off the male bird, who stood in the arena a listless, and entirely disinterested spectator. He is the mainstay of the species. Unaided, he diligently incubates the eggs and takes sole charge of the young, while his mate searches out other males to be tempted into a similar predicament. Nature is very thorough in its ministerings and seemingly backs up this mode of life, as most 'wisps' encountered during the shooting season show a great preponderance of males over females.

The Painted Snipe is not a skulker in the true sense of the word, for birds may often be seen feeding or frolicking out in the open. Their mellow call difficult to describe but unmistakeable is heard from all directions of a morning or evening. I have found the nest in several situations, always near a marsh but not necessarily on boggy ground. A tuft of short grass on a patch with squelchy puddles appears to be the favourite site. The nest itself is a firm structure made of interlaced rushes and placed only a few inches above water or marsh. The blades of grass bent to form a dome over the nest give the sitting bird shelter both from sun and view. The clutch, usually consists of four beautiful eggs of a stone colour boldly blotched and speckled with a rich brown.

The birds breed profusely in Kashmir. Many nests with full clutches have I to take pictures. The bird never gave any trouble and gliding on to the nest with usual disconsolate look, reaching up occasionally to try and repair the covering, disturbed during the clearance of the foreground by the photographer. He sits gasping with open bill and assiduously broods the eggs.

Five futile sessions, covering long hours, were wasted in my efforts to picture the female bird. Dozens could I have taken of the cock bird in that time. It was the shikari's suggestion 'perhaps the female does not brood her eggs'—that brought me to my senses. Next day a nest, containing only two eggs was chosen, in the hope that Milady would oblige by paying a visit to the nest to complete her clutch. Fortune smiled fair; I took three pictures of the beautiful female in quick succession. It was now deemed gentlemanly not to inconvenience her any longer and so all ended well. The pictures turned out to be good and the bird added her third egg to the clutch.

The Turkestan Water-Rail. *Rallus aquaticus korejewi.*

The warm brown upper parts, neatly spotted and streaked with black, the face, throat and underparts of french grey broken by the black and white patterned flanks are distinctive and give to the plumage of this Water-Rail a quiet and colourful aspect. The bill is long and red.

As a subject for the photographer, the bird is second to none—a worthy opponent, being the most secretive and in consequence the most difficult to watch of all the marsh birds. Its habitat is usually in the heart of extensive water-logged areas, covered in dense reed, out of reach of canoes and thus seldom disturbed. Even should an entry be made after great effort, the chances of seeing the bird are still remote.

During the month of June the breeding call will attract attention, and if uttered at close quarters, its vehement cadence and unearthly rumble is startling in effect. I well remember the great surprise at my first experience of this uncanny gurgle at close quarters. Instead of some pre-historic monster, a small bird, the size of a pigeon, stepped into view, jerking its head and flicking its tail in characteristic water-hen fashion. The discovery of the intruder in its stronghold, soon ended this first view. With head and red bill extended in line or with the body the bird left me a view of its small triangular cocked up tail, as it hurriedly scuttled back into cover. I have been lucky in getting opportunities for watching this seclusive bird at close quarters. Despite its repertoire of disconcerting discords the cooing dove can scarcely give its points at love-making. The nest is made of dry rushes and as a rule placed in very thick cover, not more than a foot or so above water. The eggs, normally numbering eight to a full clutch, are a shade of green, spotted red.

The bad going to the nesting site, the necessary disturbance to the area in order to open out the foreground, the enforced quiet vigils in the steaming reed-beds, make the taking of a series of pictures of the bird, arduous in the extreme. The first day's photography produced only three exposures at intervals of roughly four hours apiece, and as it was considered that a further session at this nest might destroy the eggs, a second nest was found, demanding as much patience and similar action. As luck would have it, a third nest, found late in the season, provided an easy day with many interesting exposures. This nest was placed in lighter cover within reach of the dyke wall and held heavily incubated eggs, which, I am sure, emboldened the parent bird to disregard the clicking camera.

The dozen or so pictures taken of this extremely shy bird form a most cherished record in my collection.

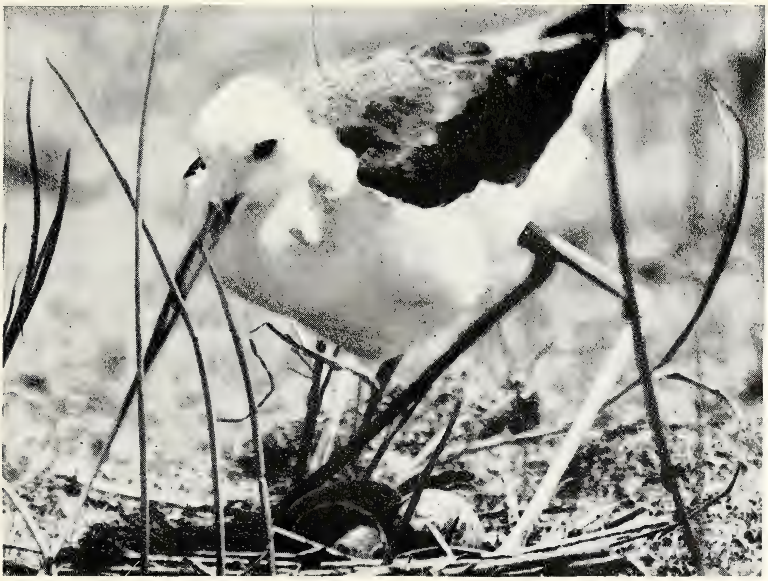
The Eastern Baillon's Crake. *Porzana pusilla.*

The little rufous-brown Crake, of about the size of a Quail has most of the habits of its genus. In keeping with family custom, it is a skulker in marsh and reed-beds. It can often be flushed however and will take to wing, legs dangling, and fly well for a short distance before pitching again into cover. At close quarters the curiously haphazard smearings of white on its upper plumage are plainly seen.

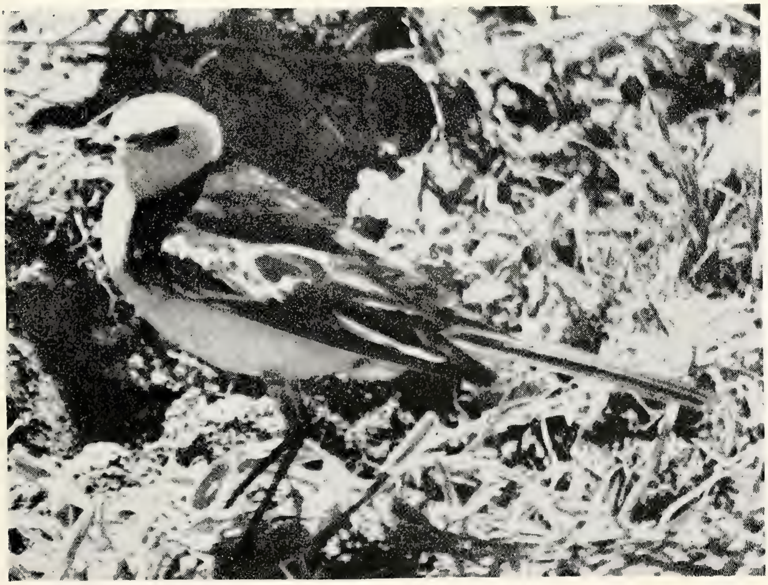
Although a skulker, this tiny crake prefers the reeds on the outskirts of dense cover for its nesting site and also values shelter in patches of short grass growing in a treacherous bog. As far as can be remembered all nests found in tangled grass had some leafy plants very near to them, perhaps to serve as a land-mark. Most July nests were found in open sites, enabling the watcher to get many unobstructed views of the bird striding over lily leaves or submerged reeds.

The nests are most difficult to find, as at the least sound the bird quietly creeps away, but my bird-shikari is particularly expert at laying back reeds, and as if by magic, disclosing nests. It was noticeable though, that his thrusts with the punt pole were invariably directed towards some leafy plant in the tangled reeds. The rush nest, placed in a tuft of grass close to water or marsh, usually contained 7 to 8 eggs. It was shaded under a canopy made by the drawing together of the tops of the surrounding grasses.

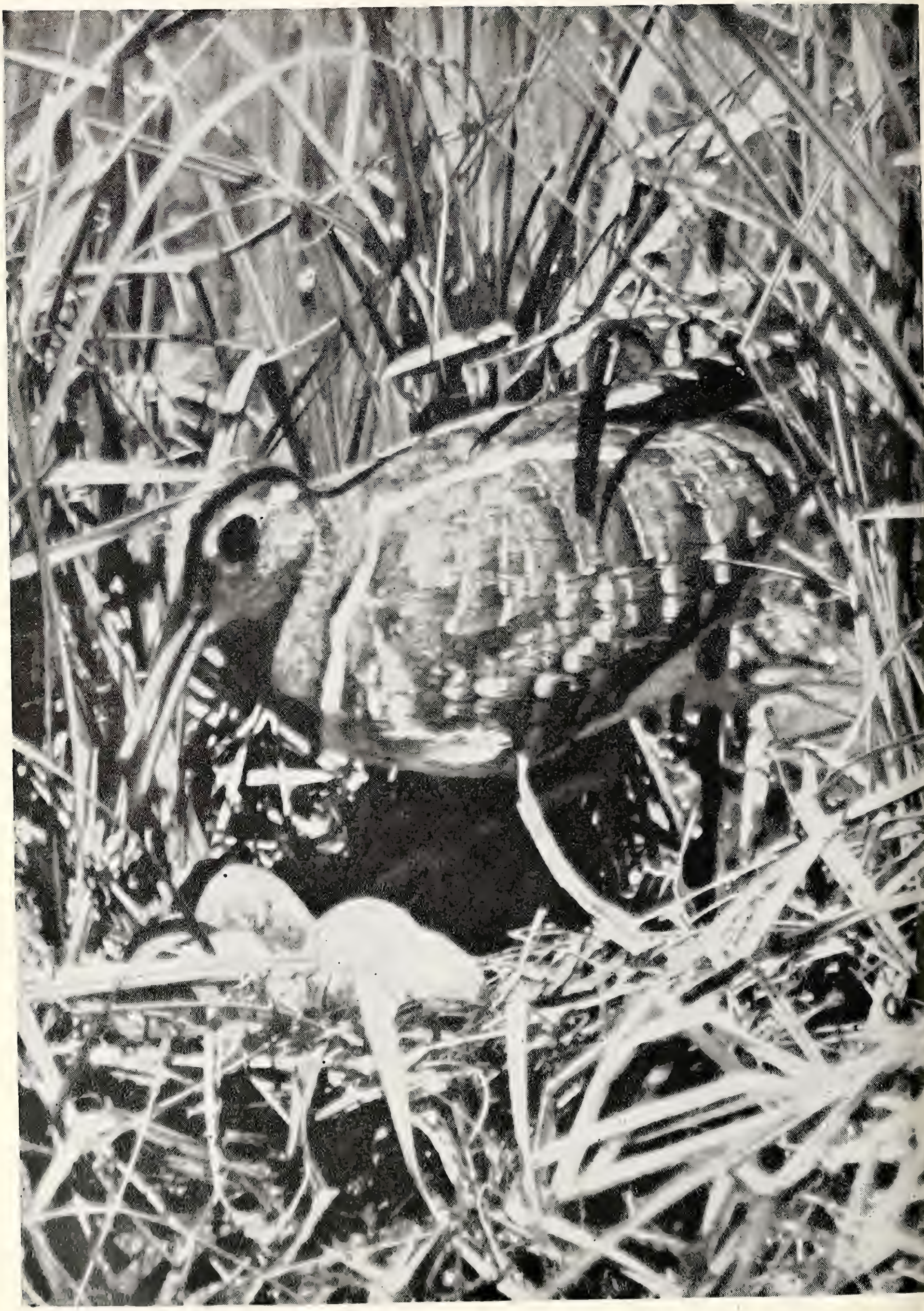
My favourite reach in search of these birds was on a particularly treacherous bit of ground, where every footstep was insecure owing to the spongy bog. On one particular occasion, urged on by the deftness with which the shikari got over this ground, shod in a contraption made on the snow-shoe principle, I donned his pair but my heavy weight soon broke through the crust, and the firmly fastened shoes, covering, as they did, a large area, jammed in the bog and imprisoned me. Had it not been for the two followers in attendance, my skeleton might have been all that remained to show where an over-zealous sportsman died in search of a tiny bird.



The Black-winged Stilt.



Hodgson's Yellow-headed Wagtail.



The Painted Snipe.

I should imagine this crake is of a pugnacious nature judging by the annoyance shown on its return to an 'opened to view' nest. Its ill-tempered and impatient efforts to rearrange the cover to true rail liking, its gruntings and constant movements presented a problem to the waiting photographer.

The Northern Ruddy Crake. *Amaurornis fuscus bakeri.*

This Crake, though imbued with the secretive habits of its genus, is much easier to observe as it commonly struts about the open edges of the reed beds and even feeds in rice fields. It is a dark brown bird the size of a Common Mynah, the rufous tinted mask and under parts, together with the long red legs help to brighten up an otherwise sombre garb.

Nesting sites in dense reed-beds are less sought after, and generally speaking the belts of light grass on the bunds bordering such fields form the most favoured sites. The nest of interlaced reeds or grass is placed either on the ground or supported by grass only a few inches above water. This bird is as prolific as its cousin. A full clutch usually contains eight eggs. Being a late breeder, nests with full clutches are not found before the first week in July. The advantage given to the photographer by the easier-going and an accommodating subject is much minimised by the attacking hordes of mosquitoes. Only part of a day was necessary to obtain all the pictures required. Twelve exposures were made in the space of a couple of hours. But time did not hang on my hands in this bird paradise. Before dusk that evening sets of pictures of the Paddy-field Warbler and the Rufous-backed Shrike had completed the only remaining film pack which had been brought out in reserve. A grand day indeed out in the bush.

Though I am very careful in replacing bent, submerged or tied-back grasses and restoring the disturbed site to normal, I am sorry to have to say that on my return to the site next day (a usual habit of mine to make sure that the bird has not deserted), I was furious to find that a tragedy, the first and so far the only one to my knowledge, had taken place. A couple of jackdaws had spotted the nest while I was busy the previous day. Their persistant attempts at rifling the nest were recalled. The sight of the empty egg shells, sucked dry, floating on the water, decided me always in future to carry a catapult as a deterrent to such prying-eyed rascals.

The Kashmir Paddy-Field Warbler. *Acrocephalus concinens hokrae.*

This Warbler is about the size of a Sparrow, and when seen in July, has an earthy brown upper and buff lower plumage. It looks like a smaller and more elegant edition of the Great Reed Warbler but happily, lacks its incessant and aggravating clamour. It is a late breeder, not commencing operations till early in July.

Although not rare on the Kashmir lakes in summer, I have actually watched and pictured this bird only on one occasion.

The nest was a very neat little cup of twisted grass, with the deep egg cavity lined with finer grasses. It contained four eggs. It was found in a dense bed of a finer species of grass, fixed to four growing stems, about three feet above the surface of the water.

The bird was not shy, but formed a difficult subject to portray owing to its jerky way of climbing up the stems and its hasty jump into the nest when all but head and tail becomes obscured.

Hodgson's Yellow-headed Wagtail. *Motacilla citreola calcarata.*

The male bird in breeding plumage is striking and a study in black and yellow, the whole head and lower plumage being a bright yellow, accentuated by the deep velvety black of the upper plumage which is relieved only by the narrow white edgings to the wing coverts and quills.

The female, though dainty withal, is drab in comparison. There is a very little yellow in her make up, the markings in her plumage vary to such an extent, that one is forced to look upon her as a nondescript pied bird. The obliterative effect caused by these unstudied haphazard lines, when placed against the play of light and shade of the grassy background, is remarkable. I have three perfect colour transparencies which illustrate this point very well. In spite of the bird being in the immediate foreground and broadside on, only a few in an audience can pick her out, although she is projected life-size on the screen. These birds are rarely seen far from marshland, but none-the-less, exhibit all the characteristics of wagtails—the brisk walk, the up and down flirting of the tail, occasional flutters into the air in chase of insects, and the 'Chiz-zit' call-note, uttered during their strong, undulating flight. The nest is a very compact affair cosily lined with wool or hair and is placed on dry ground tucked away in tufts of short grass. A variety of sites are chosen but all located on strips of dry land well out in the centre of swamps. Favoured spots include a cleft in open waste land—or more commonly in tufts of grass on the boundaries between rice fields, those repositories impregnated by the nasty organisms that deal out the 'jheel itch'. The eggs numbering four—even five have been found—are very heavily spotted almost to the point of entirely covering over the grey green ground colour. One of these nests contained a cuckoo's egg. I was glad of the opportunity offered of promptly destroying it to save the lives of the remaining four unborn wagtails. The birds are neither shy on their nesting areas nor when stalked in the open. The picture of a male bird, perched on a solitary dark green stalk protruding from out of the deep blue water of the jheel, is a pleasing sight.

The Indian Pond Heron. *Ardeola grayii.*

The mystery bird is what I call it—the Pond Heron or Paddy Bird—will surely be seen as one moves along swampy waterways, but that only, if it be striding along with slow deliberate walk. Otherwise, if standing still, its dingy dress assimilating with its reedy surroundings, cause it to escape detection. On the wing a great transformation takes place. Its drab garment changes to white liveliness, as with hoarse squawks it flaps away.

The Paddy Bird is a later breeder than the other herons of Kashmir and in consequence is not found colonising the many heroneries dotted about the Vale. This bird commences building its nest of sticks during the second half of May, and their blue green eggs are abundant in early June. The nests are placed in the branches of the semi-submerged willow trees at a height of ten to thirty feet above the water. Many pairs use the same plantations, found scattered about the margins of the jheels.

The male bird at this season replaces his dingy garb for a maroon mantle embellished with plumes in place of the long hair-like feathers. The deliberate tread used when stalking in the marshes is repeated when with measured step the bird clambers along the branches to its nest.

Beyond the trouble caused by having to transport a big stand and step ladder to get at the nest, photography is simple. It is further helped by the fact that the bird is confiding, nor will it leave its eggs unguarded to the tender mercies of the House Crow, which also breeds in this area at the same time. A catapult in hand had its uses on this occasion and helped drive away the bolder spirits among that band of robbers.

THE LÄMMERGEIER (*GYPAËTUS BARBATUS*) LINNAEUS

BY

E. H. N. Lowther, M.B.O.U., F.Z.S.

(*With* 6 *plates.*)

Just as the ambition of every British bird photographer is to portray at the nest the lordly Golden Eagle, so too does his counterpart in India always yearn to photograph the majestic Lämmergeier at home in its Himalayan fastness. Nor is this surprising. Even if we have not had the good fortune to feast our eyes on the bird when soaring over its native heath we must have been enthralled by what the most eminent authorities say concerning it. Stuart Baker refers to it as 'this magnificent bird'; A. E. Jones, the veteran ornithologist of the Simla hills, who probably knows more of the lämmergeier's day-to-day habits than any other person alive, describes it as being 'one of the finest birds in God's creation', while Whistler writes of it as 'this grand bird'. Further, Sálim Ali tells us it shares with the sarus crane the privilege of being India's largest bird. But this is not all: we are told the lämmergeier's power of flight is 'very wonderful', that it is 'the poetry of aerial motion' and that the bird rises 'upwards of a thousand feet in a few minutes in big circles without a single stroke of the wings'. If to this be added the fact that its average wing-span is nine feet and that in days of yore the bird was credited with carrying off lambs and even babies, it will readily be understood that the goal of every disciple of Richard Kearton in Hindustan must be the photographing of *Gypaëtus barbatus* at its cliff eyrie. Fond hopes and actual realisation are, however, very different matters and, as far as I know, Bengt Berg, the Swedish naturalist, and I, are the only individuals who have succeeded in photographing the lämmergeier at its nest; and my pictures were not obtained till April 1945.

Why, it may well be asked, has the lämmergeier not been photographed more often? In a measure the paucity of bird photographers in India explains matters but in a greater degree this is due to the inaccessibility of the eyrie. This is usually built in a recess or even in a small cave of a sheer cliff, and frequently an overhanging ledge protects it from falling stones. Its position therefore makes the setting up of a hiding tent a difficult matter even if we possess the necessary nerve to be lowered to the site. Another contributory factor is that the lämmergeier breeds at a time of year when the average bird photographer is content with his lot in the plains, and his imagining that because the breeding season is between November and March, it is improbable that anything will be doing at the eyrie in April, and even less during May, months which he tries to spend in the hills. Consequently once in the Himalayas, he seeks not the lämmergeier's nesting cliff but concentrates his energies on smaller fry. Wherein he makes a great mistake: at all events I did. My delight can therefore be imagined when in September 1944 Mr. A. E. Jones told me that if I could visit Simla the following April he would put me on to a lämmergeier's eyrie not ten miles distant at which he thought I should be able to photograph the parent birds. Of course, he pointed out, the young one would be fairly big then, and might not be fed as often as when small, and opportunities of obtaining pictures consequently fewer than would be the case earlier in the year. That, however, I told myself, would make no difference; and I determined there and then that if I were only shown an occupied nest nothing would prevent me from photographing the lämmergeier at home.

Early in March Mr. Jones wrote to say he had two occupied eyries awaiting me. Accordingly I 'reported for duty' to him on 10th April. Before, however, I tell of my experiences in the hiding tent it will, perhaps, be advisable to describe *Gypaëtus barbatus*, say something concerning *The Flying Dragon*, as Bengt Berg has very aptly called the lämmergeier.

Four feet in length, the lämmergeier or bearded vulture, referred to also (erroneously) as the golden-headed eagle, or simply the golden eagle (another species altogether), is usually seen in flight when the upper parts appear brownish-black with silver shafts to the feathers. The wings and tail are long, the latter wedge-shaped, a characteristic which, with the size of the bird, makes identification easy even if there were not other distinguishing features. Above the eye is a black patch which extends forwards and downwards in thick bristles to form a conspicuous 'beard'. The head and neck are cream-coloured as also are the lower parts, including the legs down to the knee, but the cream is tinged with a lovely deep orange, particularly in old birds, while most birds have a black gorget across the breast, more pronounced in some individuals than with others. The bill is greatly hooked and the iris light orange in colour with the sclerotic membrane (the 'white' of the eye, so to speak) blood-red, a combination which makes the bird look extremely fierce and cruel and was probably responsible for the old fables concerning the lämmergeier's depredations among mountain sheep and goats. Immature birds are a dull black and have the same black 'beard' as the adult, and appear not to assume the full plumage until they are about five years old.

The lämmergeier occurs as a resident species throughout the Himalayas and the tributary ranges in the North-West, being found from plains-level—A. E. Jones saw it at Rawalpindi, over the railway station—up to at least 24,000 ft., at which height it was observed soaring by one of the Everest expeditions. It breeds between 1,200 ft., at which elevation Jones found a nest containing two eggs in the Campbellpur district (*Journal*, vol. xxvii, p. 800), and 14,000 ft., if not higher (*New Fauna*), the breeding season extending from November to March (Whistler's *Popular Handbook*, 3rd edition). The nest, a huge pile of sticks, branches, grass, wool, skins, bones or rags, is built in a recess or small cave of a sheer cliff, as already indicated, and may contain anything from one to three eggs, often one only being laid, two

THE LÄMMERGEIER

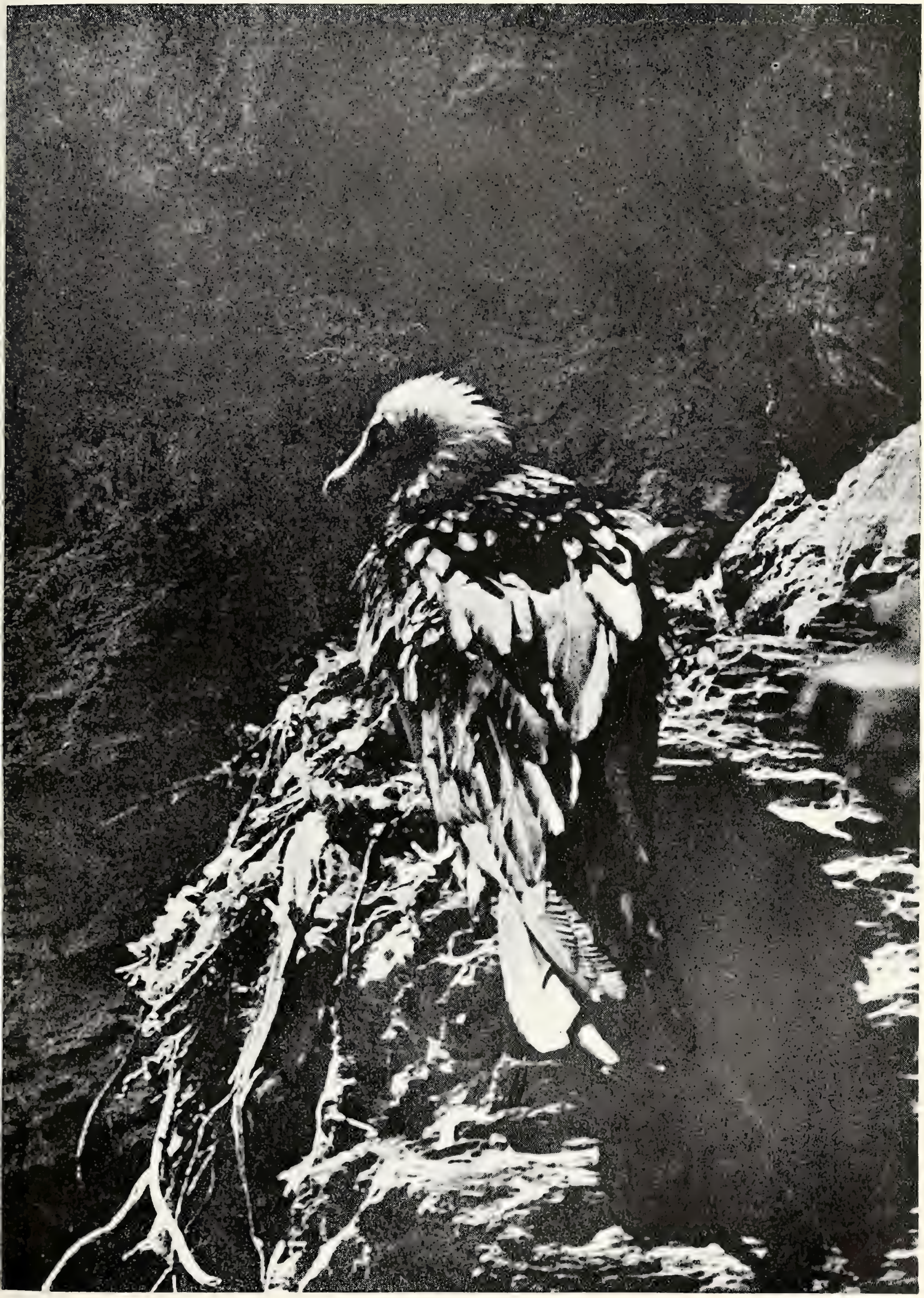


Photo by *E. H. N. Lowther.*

' The goal of every disciple of Richard Kearton in Hindustan must be the photographing of *Gypaëtus barbatus* at its cliff eyrie '.

THE LÄMMERGEIER

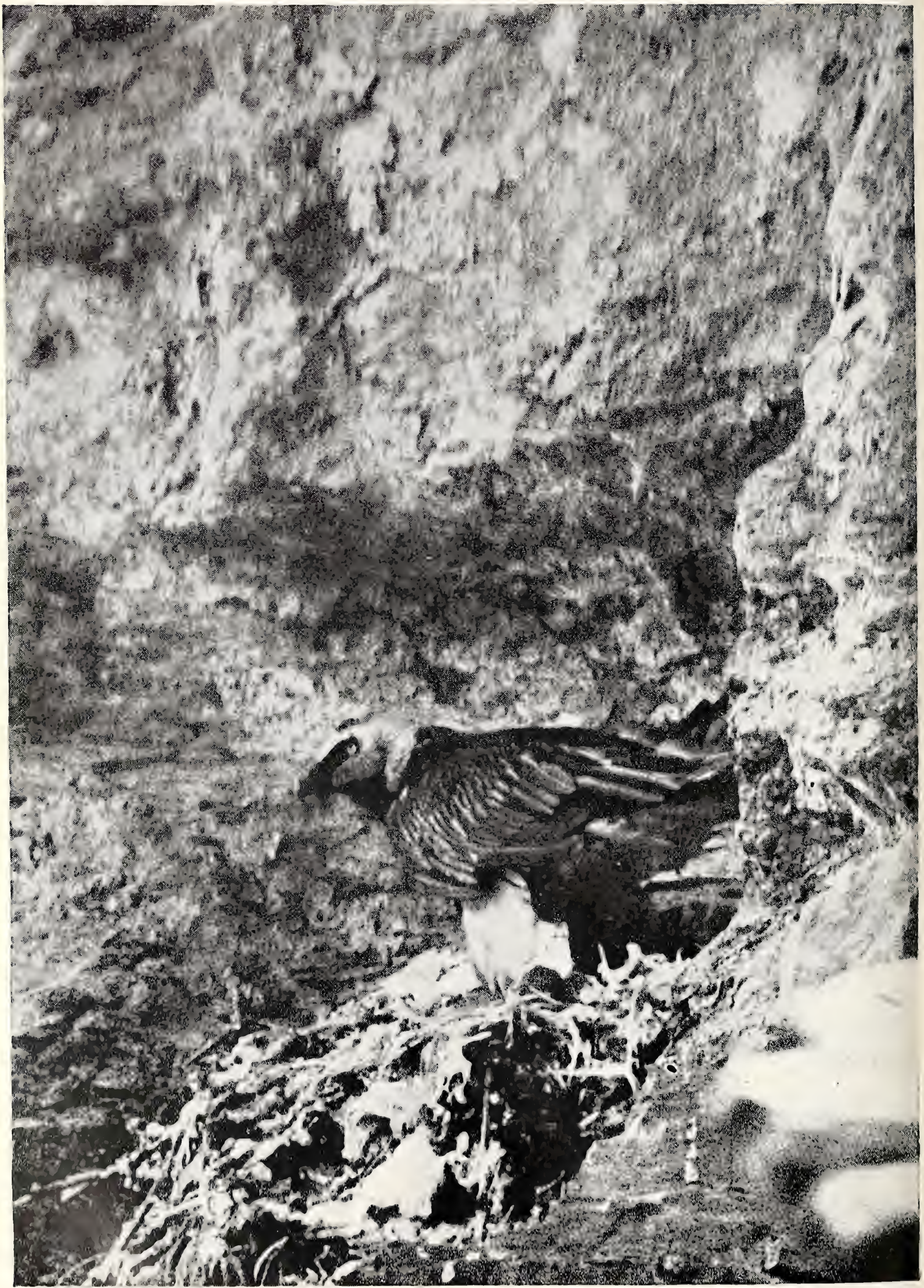


Photo by *E. H. N. Lowther.*

'One of the finest birds in God's creation'.

being the usual clutch, and three very rare, Mr. A. E. Jones having once only found a nest with this number. No matter how many eggs are laid, I learn from Mr. Jones that he has never known more than one young reared from any nest. I learn further from him that each pair of birds usually has two or three nest-sites and that even if one is occupied for two or three years in succession it may be abandoned for no obvious reason in favour of one of the others and yet be used again subsequently.

Despite the fact that it is generally considered to be the connecting link between the Vultures and the *Falconidae*, the lämmergeier is in habits a vulture albeit a very magnificent one. The best authorities are agreed that its food for the most part consists of bones, the smaller ones being bolted whole, the larger carried up into the air and dropped on to rocks, the resulting fragments being swallowed later: whence it derived another of its trivial names, ossifrage (bone-breaker). It also seems to be agreed that the lämmergeier is given to a carrion diet and even visits rubbish heaps at hill stations, both of which facts agree with my own observations. It does not, however, fight with other vultures for the tit-bits of a carcase; instead, should it visit one while the filthy meal is in progress, the lämmergeier stands by, looking on till the other vultures have left—and they do not depart until the carcase is cleaned—when it sets about the blood-covered bones of the dead animal, an incident witnessed by a number of observers including myself.

While it is agreed that the lämmergeier is a scavenger and lives on bones, carrion and offal, it is by no means clear whether it sometimes attacks or kills animals or birds; and yet the belief is common that it does. Even though a great deal of literature bearing on the subject is not to hand as I write, I find it stated in three places that the bird sometimes kills its food: by Whistler in the *Popular Handbook*, Stuart Baker in the *New Fauna*, and Colonel A. E. Ward in the *Journal*, vol. xvii, p. 728. As the matter is one of importance it will be as well to quote in full what each says on the subject. Whistler writes:—'living things it seldom kills'. The *New Fauna* observes:—'they have been seen to carry off fowls, wounded game-birds, such as partridges, pheasants, etc., and Ward records finding a hare in the stomach of one bird'. Col. Ward reports:—'I have taken mouse-hares out of specimens shot, and on one occasion this vulture took a wounded chukor which was crouched on a rock.'

These statements, to my mind, are not convincing. Nowhere amongst Whistler's numerous writings can I find any reference to his having personally seen a lämmergeier attack an animal or bird, wounded or otherwise; nor does he quote any other ornithologist to support what he states. These same observations apply equally to most of what is stated in the *New Fauna*, and one cannot help feeling that because a dead animal was found in the stomach of a lämmergeier—it will be noted that they were mouse-hares and not a hare—it appears to have been presumed to have been killed by the bird. Presumption is not proof and we are left with Ward's record of the taking of a wounded chukor. Whether this incident was witnessed by himself or somebody else is not clear, but even if it came under Colonel Ward's personal notice, might not the lämmergeier have taken the wounded bird to be a dead one? We are told it was crouching and it is conceivable that the attitude adopted by a wounded bird may sometimes be that of one which is dead. *Per contra*, though it is no proof that the bird may not occasionally resort to killing, it is significant that two such careful observers as Messrs. B. B. Osmaston and A. E. Jones, both of whom know the lämmergeier well, state that they have not seen it attack or even threaten a living animal, a statement which, in the latter's case, includes birds, and probably also where Mr. Osmaston is concerned. Apart from these considerations, however, it must be emphasised that *Gypaëtus* does not swoop down on its dead food and carry this off in the way the kite does; instead, after alighting near by, it approaches it carefully. When such is its attitude towards offal, bones, etc., it seems improbable that the lämmergeier will attack a living animal or bird particularly as its feet are not adapted to this end: the claws are blunt like any other vulture's and not curved and sharply-pointed as in the case of eagles.

Personally, I should like to think that the lämmergeier is a killer, but with the existing evidence, and considering its structure, I cannot bring myself to believe that such is the case: whatever may be its correct position in the avian hierarchy, its habits are those of a vulture.

And now it is high time we visited the eyrie at which my photographs were obtained. The illustration gives a good idea of the precipitous crag on which it was built and the attendant difficulties of portraying the bearded vulture at its nest which, in this case, faced north-east and was situated at an elevation of about 6,250 feet. (The lowest elevation in the Simla hills at which Mr. Jones has found a nest containing eggs is 2,500 ft.) My first impression was that the lämmergeier must be the King of the Rag and Bone merchants, for the nest was a huge collection of soiled sticks and dirty old rags and pieces of wool, with a large piece of sacking billowing in the breeze; this the bird must have had considerable difficulty in carrying. On these reposed pieces of green bottles, old bones—real veterans these—and horns. The far wall was white with droppings, possibly of years. Presently, as I reconnoitred how to reach the eyrie, where best I could position the *hide*, the female parent—larger than her consort—came into view. After soaring round a few times on motionless wings, she settled on a ledge of an opposite cliff. The bird had nothing in its bill and apparently nothing in its feet: I felt she had merely come to see the intruder on her domain. I was mistaken—it had brought a dead jungle crow, concealed between its 'Oxford bags' well tucked up against the body. This it proceeded to tear to pieces and swallow. After a few minutes, seizing in its feet what was left of the corby—I had in the meantime moved away from the nest's immediate vicinity—the lämmergeier sailed across to its nest, the crow visible as the bird took off but completely hidden again when the feet were drawn up against the abdomen. There now proceeded from the eyrie much squealing, and I came to know it contained a single young one. This was

THE LÄMMERGEIER

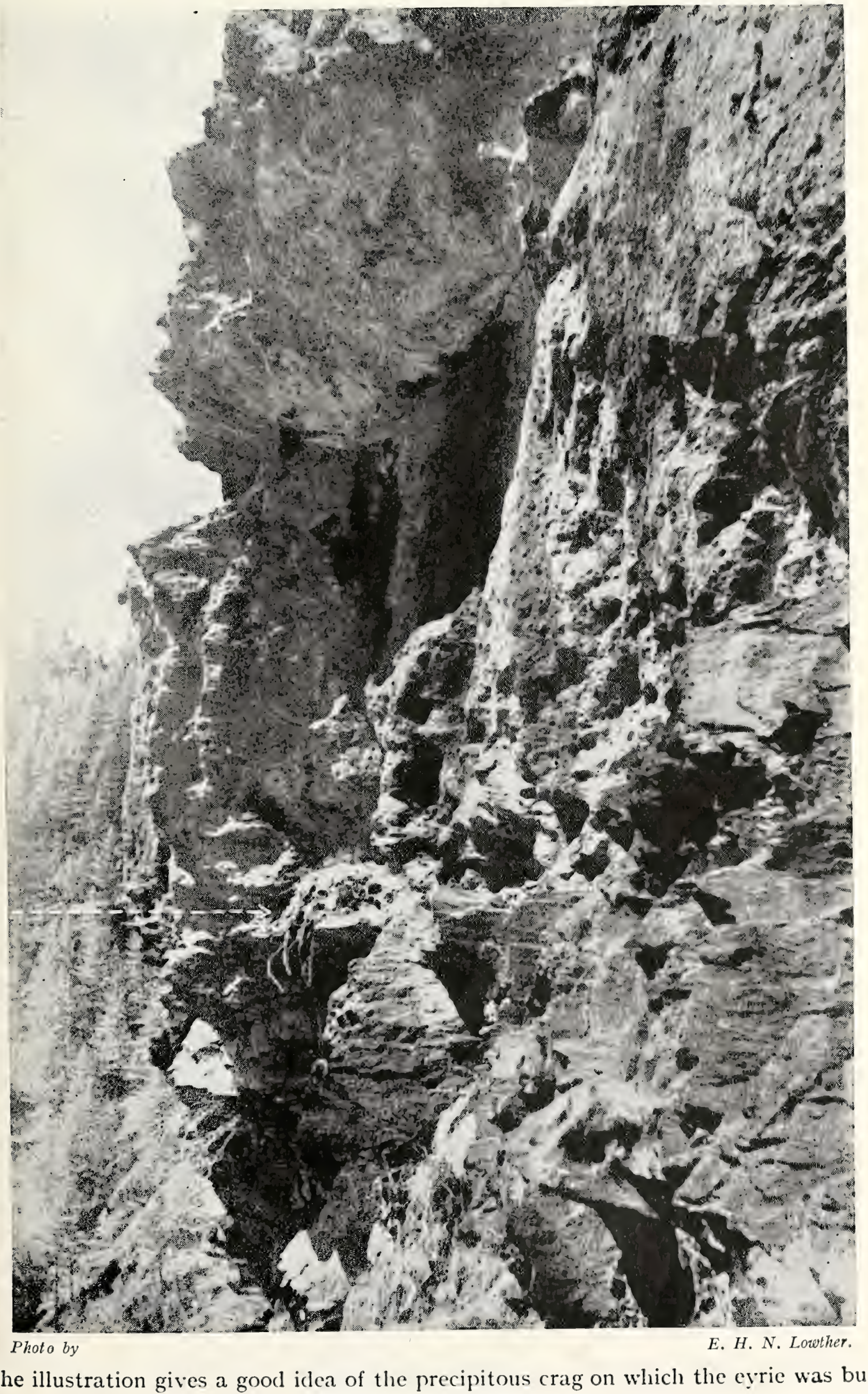
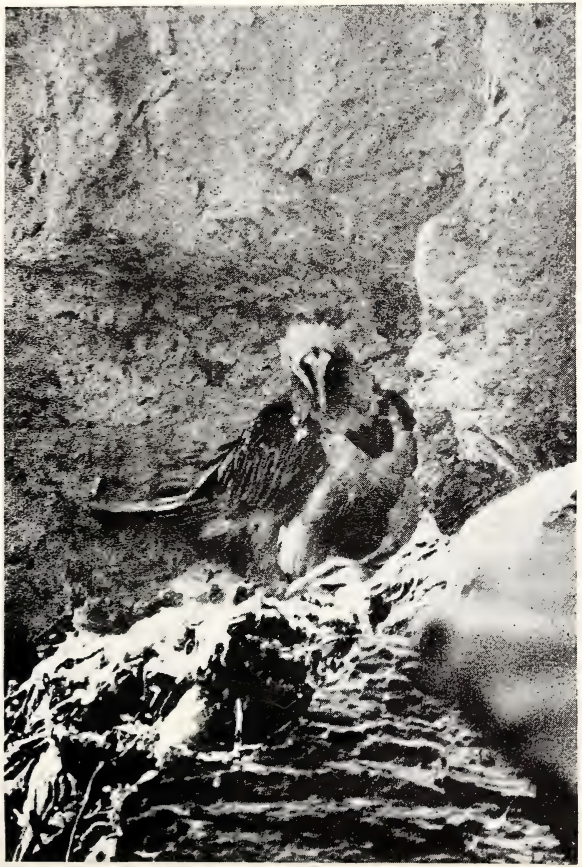
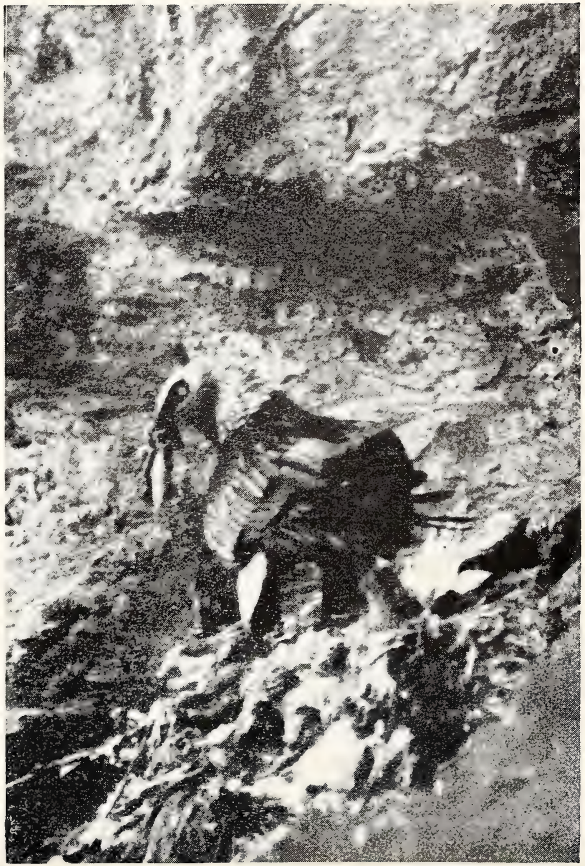


Photo by *E. H. N. Lowther.*

'The illustration gives a good idea of the precipitous crag on which the eyrie was built'. Arrow marks the nest.

THE LÄMMERGEIER





Photos by *E. H. N. Lowther.*

' The noise of the focal plane shutter going off caused the

A tit-bit for the squab.

dark brown in appearance and fairly well-feathered but still covered with a great deal of earth-coloured down, particularly on and under the wings, about the legs and on the body, and fell over when it toddled forward. My estimate of its age was a month to six weeks. Soon the lämmergeier emptied its maw on to the floor of the nest, in stages, as shown later, and gave the regurgitated food to the squab. Finally it tore off pieces of flesh from the crow's carcase and fed these, one at a time, to its offspring which, throughout, shook its wings in an importunate manner and never ceased squealing.

The lämmergeier spent about ten minutes at the eyrie and on its departure the young bird retired to the far end of the nest, to be invisible to the public gaze.

Investigation showed I could not work this nest from above: either I would be too close, or if I located the tent on a further narrow ledge, my view would be obstructed by a projecting rock. The only alternative was to see what could be done from below. Fortunately the cliff here curves slightly and a spot was eventually found on which the *hide* could be positioned. It was not entirely suitable as the distance from the nest was rather greater than I should wish as well as slightly too low, and the projecting rock still obstructed my view, but pictures would be possible and the feeding of the young bearded vulture interfered with little, if at all: which mattered most.

The *hide* was put up on the 13th April, in the morning, and beautifully camouflaged on all sides as well as the top. This done, I proceeded to a suitable vantage-point some distance away, to study through the glasses the lämmergeiers' attitude towards the encroachment on their nesting-site as well as to observe the bird-life and scenery about me.

In front was a fairly wide valley; beyond, a range of snow-covered mountains. The stream running through the valley was now dry but pools occurred here and there, at which *dhobis* banged clothes on the rocks, whistling through their teeth as they did so. On the mountain-side garments of many colours were drying in the sun. Further away were scattered villages and hamlets, and on the left a fair amount of cultivation. Hard by, a small stream trickled over boulders, the water borne away in channels to irrigate the fields. Here, two Himalayan whistling thrushes vied with one another for the possession of a third, and a pair of white-capped redstarts, gloriously handsome in their immaculate white, and bright black and chestnut livery, spent a couple of days before moving on to their breeding grounds higher up. On the cliffs were numbers of kestrels. Again and again these chased jungle crows which ventured too close to their nesting-sites, squealing fiercely as they did so, or flew around for sport, opening their tails fanwise as they 'banked', showing off then to advantage the characteristic black band, the males most handsome. Two small parties of slaty-headed parakeets dashed by, going up-hill. Common Indian swifts were busy visiting chinks in the cliff about the lämmergeier's eyrie where also blue rock-pigeons were interested in sundry crevices, while striated swallows investigated their old nests under adjoining ledges. Overhead sailed huge

Himalayan griffon vultures in different stages of plumage, looking like aeroplanes, and large scavenger vultures which appeared whiter than I had ever seen them. From the green crops below came the emphatic, rasping notes of the black partridge, a call which once learnt can never be mistaken for any other. Down in the valley, about habitations, hoopoes *uk-uk-uk*ed, and for the first time this season I heard, faintly, the welcome notes of the Asiatic cuckoo. Day by day these came nearer and inside the week the bird was uttering its familiar call on the outskirts of Simla itself. On the rocks large lizards lazed, basking in the sun, black in appearance. Surely, I thought to myself, these will later be snapped up by the kestrels, to feed their hungry families?

As I sat surveying the countryside, listening to the various bird calls about me, grateful for being out of the heat of the plains, suddenly a lämmergeier came into view, a mile or more away, contouring on motionless wings the mountain-sides, but approaching the nesting-cliff. A couple of minutes later it was less than thirty yards distant, often above, sometimes below me, very handsome in its silver-shafted plumage and the creamy-orange head, neck and lower parts. At this range the bird looked enormous. Round and round it sailed, now peering to the left, then to the right, the 'beard' very prominent. Often it seemed that the bird would settle by the nest. Each time, however, it caught sight of the *hide* and as frequently sheered off, the baby vulture squealing querulously whenever it glimpsed its parent.

It was clear that the lämmergeier did not like the look of things, that it was reluctant to return to the eyrie, for presently it alighted on a ledge of the cliff above me. I now remembered, from what I could understand of the Swedish text, that Bengt Berg had found the bird to be very scared of his hiding tent and at one time feared it would desert its nest. Was history going to repeat itself? An hour, two hours passed, and yet the bearded one had not ventured to its eyrie. I was beginning to think I must demolish the *hide*, erect it further away in the first instance, when the second bird put in an appearance, actually using its wings. Both parents were now circling round me, in opposite directions, but soon, to my intense relief and joy, the new-comer settled on the nest, followed immediately by her mate. The latter, having brought up food from the crop, departed in a hurry, leaving the mother bird to give the squab an ample meal. She was at the nest quite a quarter of an hour.

This was the only occasion that I saw both parents at the eyrie together.

Now I was happy again; now I felt certain that on the morrow, given fine weather, the lämmergeier would enter my 'studio', that I would add its portrait to my collection of 'Celebrities'; and I went to sleep that night looking forward to a full and exciting day on the 14th April.

Most people are aware of the fact that the bird photographer is accompanied to the hiding tent by an assistant, his principal duties being to see that no camouflaging material is likely to blow across the lens, and to depart ostentatiously so that the bird it is intended to photograph will imagine the tent is now deserted. With

THE LÄMMERGEIER

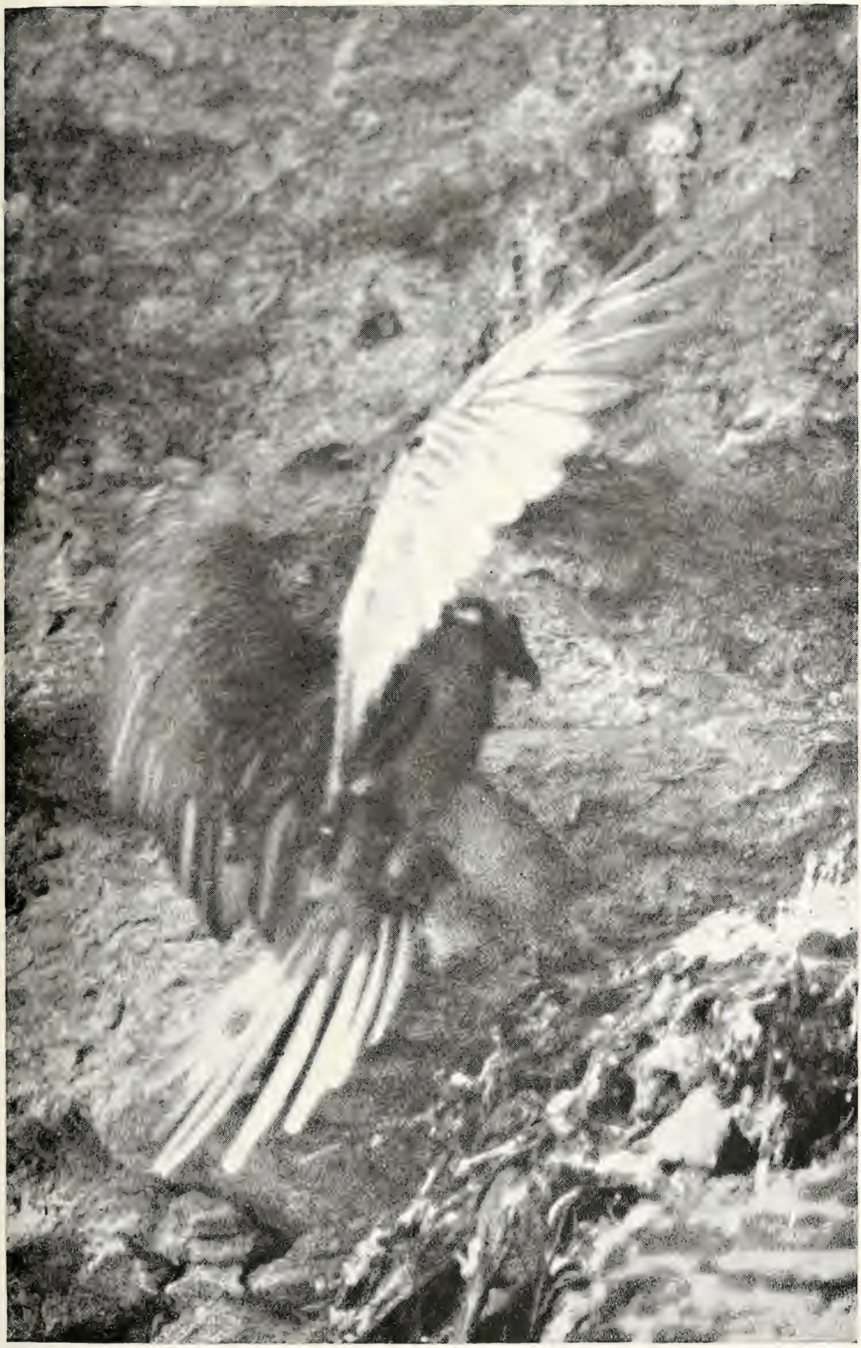
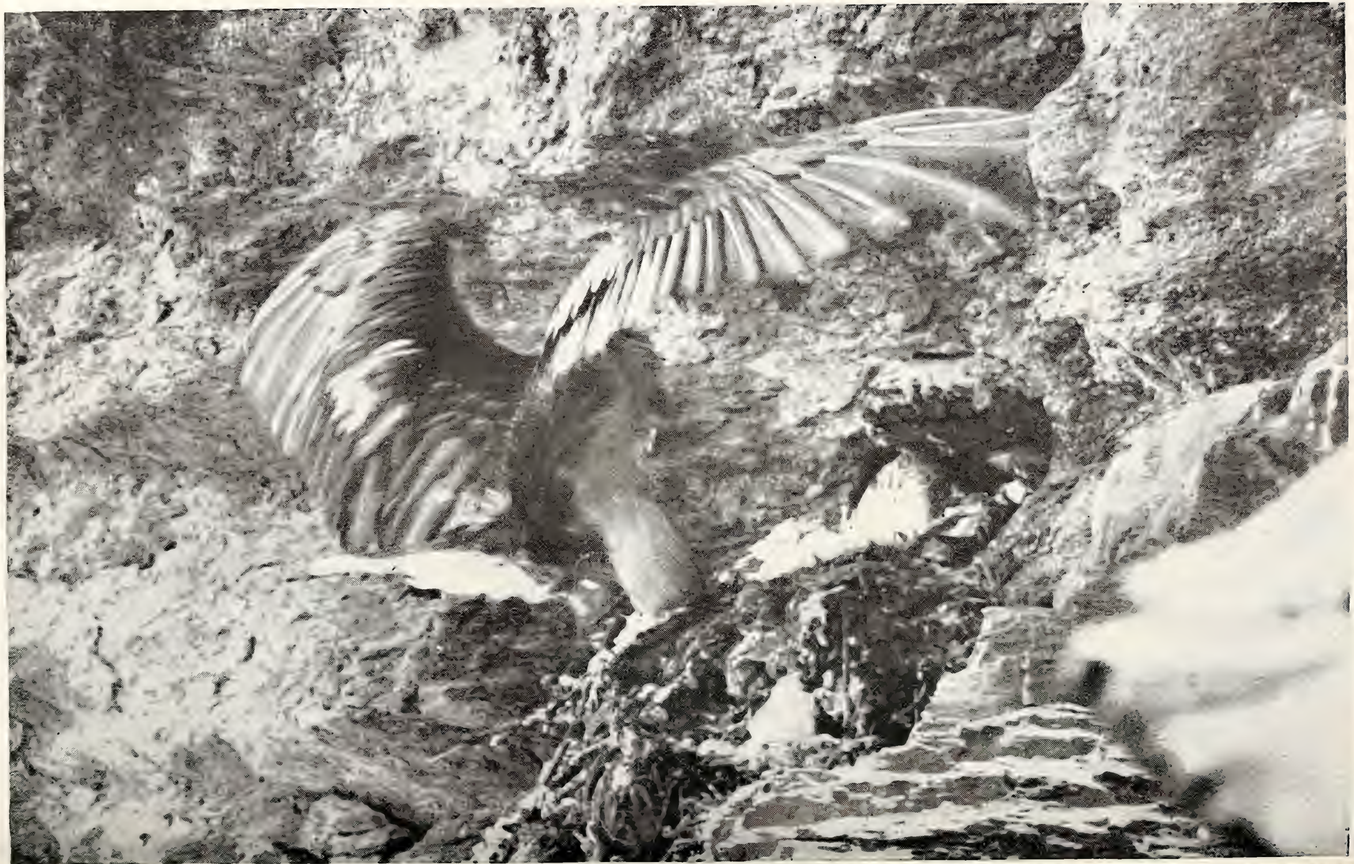


Photo by *E. H. N. Lowther.*

My efforts at portraying the lämmergeier arriving at its eyrie were greatly simplified by the young bird giving warning of the parental approach'.

THE LÄMMERGEIER



“ As the huge bird dropped with

the lämmergeier, however, I took no risks, and *two* assistants saw me into the *hide*. That they did their work efficiently, and the bearded vultures had accepted my shelter as a natural part of the cliff, was clear a quarter of an hour after they left me, when the young lämmergeier started squealing and showed itself at the fore-part of the nest, the movement causing a swarm of flies to rise into the air. A few seconds later the male parent alighted at the eyerie but for some minutes did nothing except gaze in my direction or down the valley. Seen at such close quarters the bird looked extremely fierce and powerful, and one could understand how it was that earlier generations endowed the ossifrage with extraordinary and quite unnatural powers of strength. The squab continued to give tongue throughout but did not use its wings as it had done when first I saw it; nor were its pinions employed again when being fed, or in anticipation of being given food, during the six days spread over a period of three weeks, that I spent watching the birds.

On this occasion, as on every other when the food brought had to be regurgitated, the young vulture was fed towards the back of the nest. The parent's head and neck were then hidden from view by the rock referred to earlier. Nevertheless there was no difficulty in telling when the bird was being 'sick'—anything from four to six times at each session—its body assuming a strained poise as when a dog vomits. It was equally easy to know when the disgorged food was being given to the squab. Food was given to the chick as and when disgorged, before more was brought up.

The young vulture was not fed by regurgitation alone though this was the usual mode of feeding: occasionally the lämmergeier arrived with the meal held in the bill—once it was a rat—but more often in the feet. It was the exception for the young bird to advance to the front of the nest on the approach of a parent when the meal was to consist of regurgitated food: it seemed to know when it was to be fed in this manner though its judgment was at fault on two occasions. When, however, food was brought held in the bill or feet, the squab invariably moved to the exposed part of the eyrie and there partook of the banquet provided, squealing the whole time. On these occasions the noise made in tearing off a piece of flesh or breaking a bone—at this stage the work of the adult birds—must have been audible at some considerable distance.

Occasionally the young vulture was fed twice in half an hour but the interval generally varied from one and a half to two and a half hours, while once it was over three hours. No matter when it had last been fed the squab was always ready for the next meal. It was only when the interval approached or exceeded the two-hour figure that the chick ventured to that part of the nest where I could see it. Then did it gaze anxiously all round the valley and into the skies for a sight of its parents; and if there was no sign of them it passed the time pecking about for any small piece of flesh or other unconsidered trifle which had worked its way into the nest. It was now that the squab sometimes exercised its wings, slowly and clumsily, and usually succeeded in falling over in the process. It was clear it would not be able to leave the nest for many weeks, probably not until the beginning or middle of June, just before the monsoon broke, which is the time, speaking generally, that the young lämmergeier first goes out into the world in Mr. Jones' experience.

It was not only hunger or the sight of its parents that brought the young vulture to the front of the nest. This occurred also when three blue rock-pigeons flew into the cliff with the intention of alighting on the eyrie. They almost 'looped the loop' to get away on noticing the squab inside the recess. The latter's surprise too was obviously great, for it came out at once into the open to have a 'look-see' what the commotion was. Again, a common mynah filching material for its nest in a niche close to the lämmergeiers' home, invariably brought the baby vulture out, as also did an aeroplane which circled round each day. Strangely enough the sight of the plane made the chick squeal in just the same way as when it saw a parent approaching with food.

The longest period spent by either parent at the eyrie was seventeen minutes, this when a large rat constituted the meal. Food brought in the bill, or carried in the feet, invariably caused the lämmergeier to remain longer at the nest than stuff disgorged: in the former case each visit averaged between ten and fifteen minutes; in the latter about eight minutes.

The actual photography of the bearded vulture presented no great difficulties except that fresh plates not being obtainable in the market I had to use old stock brought back two years previously from my last visit to Kashmir. These plates had deteriorated somewhat in quality and in consequence a larger stop had to be employed than would have been the case with fresh material, the result being that that depth of focus could not be secured which one would wish. Another drawback was that, too often, owing to the young vulture being fed towards the far end of the nest, photographs could not include the head and neck of the lämmergeier. Notwithstanding this, anything from two to six exposures were made each time the chick was given a meal at the more open part of its home. Further, my efforts at portraying the lämmergeier arriving at its eyrie were simplified by the young bird giving warning of the parental approach. Thus, when nothing of interest had taken place before me for the space of an hour, or even two hours, when also my thoughts sometimes strayed to such topics as the possibility of being offered an early passage to the United Kingdom, or where I would eventually settle, my fingers were instantly brought to the shutter release-lever on hearing the squab squeal; and as the huge bird dropped with a roaring crash on to its nest-ledge, a number of high-speed photographs were obtained of *The Flying Dragon*.

Readers will realise how greatly I am indebted to our fellow-member, Mr. A. E. Jones, not only for enabling me to photograph the lämmergeier at home but also for much of the first-hand information brought out in this article. I take this opportunity of thanking him for all the help so generously given.

ASSOCIATION BETWEEN THE *MALLOPHAGA* AND THE *HIPPOBOSCIDAE* INFESTING BIRDS.

BY

M. Atiqur Rahman Ansari, m.sc.,

(*Research Student, Imperial Agricultural Research Institute, New Delhi*).

While studying the Mallophaga of the birds of the Punjab, the author came across the following two examples of phoresy between the Mallophaga and the Hippoboscidae:—

1. *Columbicola columbae* (L.): Mallophaga, was carried by *Pseudolynchia canariensis* (Macq.): Hippoboscidae, collected from the Indian Rock Pigeon (*Columba livia intermedia* Str.: Columbidae).
2. *Philopterus* sp.: Mallophaga, was carried by *Ornithoeca* sp.: Hippoboscidae, collected from the Bank Myna (*Acridotheres ginginianus* (Lath.): Sturnidae).

Ewing (1927) summarised the records of phoresy between these two groups of insects. This information has been completed upto 1937 in the present paper. It is unfortunate that in several instances full information is not available. Either the Mallophaga remained unidentified or the Hippoboscid was not determined. This detracts considerably from the already too meagre information available. The phenomenon is of such interest that it deserves a careful and extensive study.

There are only 18 instances on record in which complete information regarding the bird-lice, bird-fly and the bird-host is available.

Statement 1 gives the available records. Other necessary particulars have also been included in the statement. This analysis of the available records will help to clear the position, and attention is invited to the following points:—

(*a*) In most cases the bird-lice carried are the true parasites of the bird from which the Hippoboscid flies were collected.

(*b*) In five instances the bird-lice belong to a bird-host different from the bird from which the Hippoboscid flies were collected, but these birds are closely related to the bird-host of the lice and the commonness of the Mallophaga on the fly-hosts is a possibility.

Martin (1934) records *Columbicola columbae* (L.) being carried by *Pseudolynchia canariensis* (Macq.) from *Columba livia* Gmelin, from the U.S.A. Adie's (1915) record from India may represent the same association, as two out of three elements are common, viz., the Hippoboscid and the bird-host. The present record agrees with Martin's record in every detail, and it is interesting that in regions so wide apart instances of identical associations occur.

Regarding *Philopterus* sp. being carried by *Ornithoeca* sp., there is no definite previous record. There are records of *Philopterus* sp.

and *P. sturni* (Schrank) being carried by *Ornithomyia fringillina* Curtis and one record of *Philopterus* sp. being carried by *Lynchia* sp.

There is a single record of *Ornithoeca pusilla* Schin carrying an undetermined species of bird-louse, from *Eucichla cyanura* Bodd. from Batavia.

Mallophaga	Host from which Hippoboscid was collected	Recorded host of the Mallophagan sp.
1. *Degeeriella rotundata* (Osb.) (McAtee-1922)	*Corvus brachyrhyncos hesperis*: Corvidae	*C. americanus*: Corvidae
2. *Degeeriella deficiens* (P.) .. (Spencer 1928)	*Cyanocitta s. stelleri*: Corvidae	*Cyanopica cooki*: Corvidae
3. *Degeeriella interposita*[1] (Kell) (Ewing 1927)	*Melospiza m. melodia*: Fringillidae	*Geospiza fuliginosa*, *Geospiza fortis* and *Camarhynchus variegatus*: Fringillidae
4. do. (Thompson 1937)	*Hylocichla u. ustulata*: Turdidae	*Dendroica bryanti*: Mniotiltidae
5. do. (Ewing 1927)	*Dumetella carolinensis*: Mimidae	*Nesomimus parvulsus* and *Nesomimus carringtoni*: Mimidae

The commonest instances of phoresy are *Degeeriella* species being carried from different bird-hosts by *Ornithomyia fringillina* Curtis and *O. avicularia* L.

A species of *Degeeriella* is recorded as being carried by *Ornitheza metallica* (Sch.).

The only other species recorded is *Ardeicola botauri* (Osb.) carried by *Lynchia botaurinorum* (Swenk.).

As to the significance of this 'association' the following suggestions have been made by Ewing (1927):—

1. The Mallophaga attempt to obtain blood that the flies themselves have imbibed from the birds.

2. The Mallophaga are perhaps attracted by the higher body temperature of the fly on a dead bird.

3. The Mallophaga are attracted by some odoriferous secretion of the flies.

4. The Mallophaga use the flies as transport agency from one individual or species of birds to another and from a dying or dead host to a living one.

Considering these four suggestions more closely, we find that the first three do not hold.

1. The Mallophaga subsist on feathers, scurf, scales and other epidermal products. It is only in cases of wounds or bruises on

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[1] 'It is of interest to note the marked commonness of parasitic species to the genera *Geospiza* and *Camarhynchus*, thus lending weight to the belief of their very close relationship.'—Kellogg, V. L. & Kuwana, S.I., 1902, *Proc. Wash. Acad. Sci.*, iv, p. 459.

the host that they feed on blood. Therefore, the suggestion that the lice obtain blood from the flies, cannot be upheld.

2. The Hippoboscid flies are known to leave the defunct host almost immediately after its death while the Ischnocern Mallophaga do not, as a rule, leave it, rather die *in situ.* If ever they deviate from their usual habit they may do so only after the temperature of the dead body has decidedly gone down and that too for favourably warm places on the host's body.

In the case of crows, the lice were seen to swarm about the head region two to three hours after the death of the bird. They were apparently so panic stricken that they moved in and out the feathery covering for likely favourable spots, persistently biting the feathers here and there and attaching themselves by their strong sharp-edged mandibles to the fragments coming in their way. But they did not quit the body at all. From this it may be inferred that lice will fasten upon Hippoboscid fly, if the latter comes in the way, but not purposely for reason of the higher temperature of the fly.

3. An examination of the specimens of the bird-flies in the collection at the Punjab Agricultural College and Research Institute, Lyallpur, and the collection at the Imperial Agricultural Research Institute, New Delhi, was carried out. Forty-three specimens of *Ornithomyia comosa* Aust. from the Indian Sand Martin, twenty-one specimens of *Lynchia maura* Big. [=*Pseudolynchia canariensis* (Macq.)] from the Indian Pigeons collected from Mandalay, Calcutta, Pusa, Rawalpindi and Kasauli, and numerous unidentified Hippoboscidae from various birds were examined. Not a single example of such an association was obtained from these specimens. Thompson (1935) examined about 150 bird-flies of various species from the British Isles and Uganda, and failed to find a single instance of this relationship. If the Hippoboscidae secreted an odour attractive to the Mallophaga, the instances of association between the two bird-parasites would have been of more frequent occurrence. Therefore, the theory of attraction by the bird-fly odour does not seem probable.

4. We now consider the last suggestion, viz., that the Mallophaga use the Hippoboscidae as a transport agency from the dying or dead host to a living host, or from one individual or species to another, or in other words as a means of intra or inter-specific dispersal. It is true that the Hippoboscidae are highly specialized Cyclorrhapidae, provided with well developed, toothed or spined claws for clinging to the hosts, and possess mouth-parts for piercing and sucking the blood of the host on which alone they can subsist. They do not ordinarily leave the host until the latter dies (Thompson 1937a). However, host specificity is not a marked feature of the Hippoboscidae. Most species have a wide range of hosts and extensive geographical distribution.

Ornithomyia avicularia L. and *Ornithomyia fringillina* Curtis, the two commonest fly-partners of this association, are found on a variety of birds, such as the ravens, jays, sparrows, skylarks (Passeriformes); wood-peckers, owls (Coraciformes); hawks

STATEMENT I

Recorded instances of Phoresy between Mallophaga and Hippboscidae

Year	Author	No.	Mallophaga (Ischnocera)	Attached to	Hippoboscid	Bird host	Country
1857	Aube	2	Species not named	Abdomen	*Ornithomyia* (*avicularia ?*)	Magpie [*Pica p. pica* (L.): Corvidae]	France
1890	Sharp	several	Species not named	--	*Ornithomyia avicularia* L.	Host not named (taken on wing)	England
1910	Warnach	1	*Philopterus* sp.	Abdomen	*Ornithomyia fringillina* Curtis	Blackbird (*Planesticus m. merula* L.:Turdidae)	Germany
1910	Mjoberg	3	*Philopterus sturni* (Schrank)*	Abdominal hairs	*Ornithomyia fringillina* Curtis	*Sturnus v. vulgaris* L.: Sturnidae	Germany
		7	*Philopterus sturni* (Schrank)*	Abdominal hairs	*Ornithomyia fringillina* Curtis	*Sturnus v. vulgaris* L.: Sturnidae	Germany
1911	Jacobson	1	Species not named	Clasped between legs	*Ornithoeca pusilla* Schin.	*Eucichla cyanura* Bodd.: Turdidae	Batavia, Java
1912	Forsius	1	*Degeeriella camerata* (N.)*	Wing base	*Ornithomyia avicularia* L.	*Tetrao tetrix*:Phasianidae	Finland
		2	*Degeeriella uncinosa* (N.)*	Tibia and abdomen	,, ,,	Carrion Crow (*Corvus cornix* L. Corvidae)	Finland
1913	Harrison	1	*Degeeriella hectica* (N.)*	Abdominal hairs	*Ornithomyia* sp.	Regent Bird [*Sericulus chrysocephalus* (Lew.): Ptlonorhynchidae]	N.S. Wales
		16	*Degeeriella* sp.	Dorsal abdominal hairs	*Ornithomyia* sp.	Grey Magpie [*Strepera versicolor* (Lath.) Cracticidae]	N.S Wales
1915	Adie	1	Species not named	Wing joint	*Pseudolynchia canariensis* (Macq.)	*Columba livia* Gmelin : Columbidae	India
1920	Banks	2	*Degeeriella* sp.	Abdominal tip	*Ornithomyia fringillina* Curtis	Canada Jay [*Perisoreus canadensis* (L.) : Corvidae]	England

1922	McAtee	1	*Degeeriella rotundata* (Osb.)	Abdominal tergites	*Ornithomyia fringillina* Curtis	Host not named	Canada
		1	,, ,, *	,, ,,	*Ornithomyia fringillina* Curtis	Western Crow (*Corvus brachyrhyncos hesperis*: Corvidae)	U.S.A.
1922	Johnson	2	Species not named	Abdomen	*Ornithomyia avicularia* L.	Jay (*Perisoreus barbouri*: Corvidae)	Canada
1927	Ewing	1	*Degeeriella interposita* (Kell.)*	Postero-lateral abdomen	*Ornithomyia fringillina* Curtis	Cat Bird (*Dumetella carolinensis*: Mimidae)	Ohio (U.S.A.)
		2	*Degeeriella interposita* (Kell)*	,, ,,	*Ornithomyia fringillina* Curtis	*Melospiza m. melodia*: Fringillidae	Ohio (U.S.A.)
1928	Warburton	12	*Degeeriella marginalis*(N.)	Abdominal hairs	*Ornithomyia fringillina* Curtis	Window (? *Planesticus merula* L.: Turdidae)	Cambridge
,,	Spencer	16	*Degeeriella deficiens* (P.)*	Abdominal sternite	*Ornithomyia avicularia* L.	Steller Jay (*Cyanocitta s. stelleri*: Corvidae	South America
1933	Thompson	3	*Degeeriella marginalis*(N)*	Posterior abdomen	,, ,,	Song Thrush (*Turdus e. ericetorum* T.: Turdidae)	England
		11	,, ,, *	,, ,,	,, ,,	Window	Surrey (England)
1934	Martin	3	*Columbicola columbae* (L.)*	Carrying between legs	*Pseudolynchia canariensis* (Macq.)	*Columba livia* Gmelin: Columbidae	U.S.A.
		1	,, ,, *	,, ,, ,,	*Pseudolynchia canariensis* (Macq.)	*Columba livia* Gmelin: Columbidae	U.S.A.
1935	Thompson	1	*Philopterus sturni* (Schrank)*	Posterior abdomen	*Ornithomyia fringillina* Curtis	Starling (*Sturnus v. vulgaris* L.; Sturnidae)	England
		1	*Philopterus sturni* (Schrank)*	,, ,,	*Ornithomyia fringillina* Curtis	Starling (*Sturnus v. vulgaris* L.; Sturnidae)	England
		1	*Degeeriella marginalis* (N.)	,, ,,	*Ornithomyia fringillina* Curtis	Window	England
1935	Thompson	1	*Philopterus* sp.	Abdomen	*Lynchia* sp.	*Pyromelana orix nigrifrons* Bohm.: Ploceidae)	Belgium Congo
		2	*Degeeriella marginalis* (N)*	,,	*Ornithomyia fringillina* Curtis	*Arceuthornis pilaris* (L.) Turdidae	Sweden
1935	Peters	Publication not available to me in original					

STATEMENT I

RECORDED INSTANCES OF PHORESY BETWEEN MALLOPHAGA AND HIPPOBOSCIDAE

Year	Author	No.	Mallophaga (Ischnocera)	Attached to	Hippoboscid	Bird host	Country
1857	Aube	2	Species not named	Abdomen	*Ornithomyia* (*avicularia* ?)	Magpie [*Pica p. pica* (L.): Corvidae]	France
1890	Sharp	several	Species not named	--	*Ornithomyia avicularia* L.	Host not named (taken on wing)	England
1910	Warnach	1	*Philopterus* sp.	Abdomen	*Ornithomyia fringillina* Curtis	Blackbird (*Planesticus m. merula* L.:Turdidae)	Germany
1910	Mjoberg	3	*Philopterus sturni* (Schrank)*	Abdominal hairs	*Ornithomyia fringillina* Curtis	*Sturnus v. vulgaris* L.: Sturnidae	Germany
		7	*Philopterus sturni* (Schrank)*	Abdominal hairs	*Ornithomyia fringillina* Curtis	*Sturnus v. vulgaris* L.: Sturnidae	Germany
1911	Jacobson	1	Species not named	Clasped between legs	*Ornithoeca pusilla* Schin.	*Eucichla cyanura* Bodd.: Turdidae	Batavia, Java
1912	Forsius	1	*Degeeriella camerata* (N.)*	Wing base	*Ornithomyia avicularia* L.	*Tetrao tetrix*: Phasianidae	Finland
		2	*Degeeriella uncinosa* (N.)*	Tibia and abdomen	,, ,,	Carrion Crow (*Corvus cornix* L. Corvidae)	Finland
1913	Harrison	1	*Degeeriella hectica* (N.)*	Abdominal hairs	*Ornithomyia* sp.	Regent Bird [*Sericulus chrysocephalus* (Lew.): Ptlonorhynchidae]	N.S. Wales
		16	*Degeeriella* sp.	Dorsal abdominal hairs	*Ornithomyia* sp.	Grey Magpie [*Strepera versicolor* (Lath.) Cracticidae]	N.S Wales
1915	Adie	1	Species not named	Wing joint	*Pseudolynchia canariensis* (Macq.)	*Columba livia* Gmelin: Columbidae	India
1920	Banks	2	*Degeeriella* sp.	Abdominal tip	*Ornithomyia fringillina* Curtis	Canada Jay [*Perisoreus canadensis* (L.): Corvidae]	England
1922	McAtee	1	*Degeeriella rotundata* (Osb.)	Abdominal tergites	*Ornithomyia fringillina* Curtis	Host not named	Canada
		1	,, ,, *	,, ,,	*Ornithomyia fringillina* Curtis	Western Crow (*Corvus brachyrhyncos hesperis*: Corvidae)	U.S.A.
1922	Johnson	2	Species not named	Abdomen	*Ornithomyia avicularia* L.	Jay (*Perisoreus barbouri*: Corvidae)	Canada
1927	Ewing	1	*Degeeriella interposita* (Kell.)*	Postero-lateral abdomen	*Ornithomyia fringillina* Curtis	Cat Bird (*Dumetella carolinensis*: Mimidae)	Ohio (U.S.A.)
		2	*Degeeriella interposita* (Kell)*	,, ,,	*Ornithomyia fringillina* Curtis	*Melospiza m. melodia*: Fringillidae	Ohio (U.S.A.)
1928	Warburton	12	*Degeeriella marginalis* (N.)	Abdominal hairs	*Ornithomyia fringillina* Curtis	Window (? *Planesticus merula* L.: Turdidae)	Cambridge
,,	Spencer	16	*Degeeriella deficiens* (P.)*	Abdominal sternite	*Ornithomyia avicularia* L.	Steller Jay (*Cyanocitta s. stelleri*; Corvidae	South America
1933	Thompson	3	*Degeeriella marginalis* (N)*	Posterior abdomen	,, ,,	Song Thrush (*Turdus e. ericetorum* T.: Turdidae)	England
		11	,, ,, *	,, ,,	,, ,,	Window	Surrey (England)
1934	Martin	3	*Columbicola columbae* (L.)*	Carrying between legs	*Pseudolynchia canariensis* (Macq.)	*Columba livia* Gmelin: Columbidae	U.S.A.
		1	,, ,, *	,, ,, ,,	*Pseudolynchia canariensis* (Macq.)	*Columba livia* Gmelin: Columbidae	U.S.A.
1935	Thompson	1	*Philopterus sturni* (Schrank)*	Posterior abdomen	*Ornithomyia fringillina* Curtis	Starling (*Sturnus v. vulgaris* L.; Sturnidae)	England
		1	*Philopterus sturni* (Schrank)*	,, ,,	*Ornithomyia fringillina* Curtis	Starling (*Sturnus v. vulgaris* L.; Sturnidae)	England
		1	*Degeeriella marginalis* (N.)	,, ,,	*Ornithomyia fringillina* Curtis	Window	England
1935	Thompson	1	*Philopterus* sp.	Abdomen	*Lynchia* sp.	*Pyromelana orix nigrifrons* Bohm.; Ploceidae)	Belgium Congo
		2	*Degeeriella marginalis* (N)*	,,	*Ornithomyia fringillina* Curtis	*Arceuthornis pilaris* (L.) Turdidae	Sweden
1935	Peters	Publication not available to me in original					

STATEMENT I—(*Continued*)

RECORDED INSTANCES OF PHORESY BETWEEN MALLOPHAGA AND HIPPOBOSCIDAE

Year	Author	No.	Mallophaga (Ischnocera)	Attached to	Hippoboscid	Bird host	Country
1936	Thompson	1	*Degeeriella* (?) Lost	Abdomen	*Ornitheza metallica* (Sch.)	Kingfisher [*Halcyon juliae* (Heine): Alcedinidae]	New Hebrides
		5	*Ardeicola batauri* (Osb).	,,	*Lynchia botaurinorum* (Swenk)	On wing [? *Botaurus lentiginosus* (Montagu), Ardeidae]	Mexico (U.S.A.)
		2	*Degeeriella* sp.	,,	*Ornitheza metallica* (Sch.)	Flycatcher	Queensland (Australia)
		4	*Degeeriella marginalis* (N)*	Abdominal tergites	*Ornithomyia fringillina* Curtis	Blackbird (*Planesticus m. merula* : Turdidae)	Scotland
		2	*Degeeriella* sp.	Abdominal tip	*Ornithomyia fringillina* Curtis	Eastern Song Sparrow [*Melospiza m. melodia* (Wilson): Fringillidae]	U.S.A.
		2	*Degeeriella simplex* (Kell.)*	Abdominal tergites	*Ornithomyia fringillina* Curtis	*Turdus migratorius* L. Turdidae	U.S.A.
1937	Thompson	2	*Degeeriella* sp.	Abdomen	*Ornithomyia fringillina* Curtis	Canada Jay [*Perisoreus canadensis* (L.): Corvidae]	Anticosti Island
		5	*Degeeriella interposita* (Kell.)*	Attached to body	*Ornithomyia fringillina* Curtis	Russet-backed Thrush [*Hylocichla u. ustulata* (Nut.): Turdidae]	Br. Columbia
		1	*Degeeriella* sp.	Abdomen	*Ornithomyia fringillina* Curtis	Olive-backed Thrush [*H. ualabatus swainsoni.* (T.): Turdidae]	New Foundland

*Instances of complete information.

(Accipitres); peacocks, partridges (Gallinae); herons, egrets (Herodiones); etc. (*Psyche* 29, p. 81; *Ent. Mon. Mag.*, 73, p. 47). If the transport of the Mallophaga through this agency were a common occurrence, there would have been cases of common Mallophagan parasites on these widely separated birds. Actually the Mallophagan parasites of these birds are quite distinct and constitute well defined groups and in most cases have only one true host.

Hopkins (1939) said: 'It may be stated definitely that in most cases a given species of louse has only one true host, though it may be found accidentally on unrelated hosts and more or less normally or closely related species. As our knowledge increases through more careful and detailed work on the systematics of the Mallophaga, the number of instances in which a given species found to occur normally on more than one species of host is being gradually reduced and especially it is found that for a given species of louse to be common to two hosts, a much closer degree of relationship between the hosts is required than was formerly thought to be the case.' In the absence of definite evidence to substantiate the suggestion, therefore, the Hippoboscidae cannot be regarded as a regular and orthodox means of transport but may serve the purpose of an occasional, though important method of dispersal. The Mallophaga when transported to a suitable host may establish itself, or may die off when it reaches an unsuitable bird. This method of transport may have been responsible for some cases of plurality of hosts of some of the Mallophaga.

The Amblyceron Mallophaga are active, abound near the skin of the host and are furnished with mandibles which work horizontally, while the Ischnoceron Mallophaga are inactive, live among feathers and are provided with mandibles which work vertically. The members of the latter group when at rest maintain themselves in position by holding on to the feathers by their mandibles. It is probably on account of this habit that they cling to the flies and are the only group of the Mallophaga recorded in 'Lice-Fly' association.

Conclusion.—From the above it appears that the transport of Mallophaga by the 'bird flies' is purely *accidental*, and is not a common feature.

Acknowledgments.—The author had the opportunity of examining the Hippoboscidae of the Imperial Agricultural Research Institute, New Delhi, through the kindness of Dr. Hem Singh Pruthi, Imperial Entomologist and Director, and is greatly indebted to him. His grateful thanks are also due to Mr. M. Afzal Husain, Member, Famine Inquiry Commission, for going through the manuscript and for many valuable suggestions. The names of the birds were checked by the Bombay Natural History Society and the help received is gratefully acknowledged.

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SOME BUTTERFLIES OF THE ARAKAN COAST.

BY

MAJOR J. C. GLADMAN (*R. Signals*).

The following list has been compiled from the collection and observation of the butterflies of the Arakan coastal belt made by the author during the third and final Arakan campaign from November 1944 to the end of June 1945. The list is by no means complete, particularly as regards the butterflies of the wet season, but a fairly comprehensive survey was made of the dry season broods. The 'Skippers' were somewhat neglected and a good dozen species were seen that were neither collected nor identified. The areas in which the observations were made are listed below:—

The dense mixed jungle between Cox's Bazaar in the north to Ramkapellaung in the south; the hills and littoral of the Teknaf Peninsula.	Early November to mid-January i.e. from the end of the rains onward.
Bawli Bazaar, Maungdaw and Buthidaung; the foothills of the Mayu Range.	November and January.
Ramree Island and the islands and mangrove swamps to the East.	21 January to 11 June, including the first two weeks of the rains.
Taungup Area.	18 to 22 March. (A raid on the area during which, incidentally, one of my officers earned a posthumous V.C.)

All the specimens were taken at elevations between sea level and 400 ft. The vegetation of this coastal area is varied, but except for the jungles south of Cox's Bazaar and the hills of the Teknaf peninsular and the Mayu Range, it is nowhere very dense. Between Ramree Island and the mainland there are several miles of mangrove swamps which did not appear to support many species of butterflies.

The code numbers and classification of the butterflies in this list are according to Evan's *Identification of Indian Butterflies,* second edition, the volume that gave me my introduction to Indian Butterflies when I first arrived in this country two years ago. The months during which each species occurred have been indicated when the period covered by a brood was restricted. Where the insect appeared throughout the period of observation no dates have been given.

A map of the area may be found in Vol. 45, p. 605.

PAPILIONIDAE.

1. A 1–1 γ **Troides helena cerberus**, Fd.

Ramree, just before the rains. No specimens were taken so the identification is not positive.

2. A 2–9 **Tros hector**, L.

Locally common in E. Bengal as far south as Teknaf which is its southern limit.

3. A 2–10 γ **Tros aristolochiae goniopeltis**, Roth.

Not rare from Teknaf southwards. Specimens from further south have more extensive white markings than those from Teknaf.

4. A 3–5 γ. **Chilasa clytia onpape**, M.

5. v. **dissimillima**, Evans.

Not rare, May and June.

6. A 4–2. **Papilio memnon agenor**, L.

Common. The ♀ v. *alcanor* was not seen.

7. A 4–25 α. **Papilio polytes romulus**, Cr.

8. ♀ v. **stichius**, Hub.

9. ♀ v. **cyrus**, F.

♂ common. The ♀ *cyrus* and *stichius* forms were not rare. The typical ♀ absent in S. Arakan where *P. hector* does not fly. *Stichius* mimics the local form of *T. aristolochiae* to the extent of having very extensive white markings on the hind wing.

10. A 4–27. α **Papilio demoleus demoleus**, L.

11. A 4–27. β **Papilio demoleus malayanus**, Wall.

The nominotypical race flies as far south as the Mayu Range. Specimens of *demoleus* from Ramree southwards appear to belong to the race *malayanus*.

12. A 5–4 β. **Pathysa nomius swinhoei**, M.

13. A 5–6 γ. **Pathysa antiphates pompilius**, F.

Found round tree-tops of most hills at the beginning of the rains.

14. A 6–3 γ. **Zetides doson axion**, Fd.

Ramree, June, not rare.

15. A 6–8 β. **Zetides agammemnon agammemnon**, L.

Widely distributed, but not common. I found one newly emerged ♀ drying her wings on the barrel of a recently fired three inch mortar!

PIERIDAE.

16. B 1–α. **Leptosia nina nina, F.**

Common, found fluttering aimlessly in the undergrowth throughout the day.

17. B 4–10 β. **Pieris canidia indica,** Evans.

Uncommon.

18. B 6–4 β. **Delias hyparete hierte,** Hub.

Common, particularly from November to January.

19. B 6–11. **Delias descombesi leucacantha,** Fruh.

♂ very common, ♀ rare, although I have bred *descombesi* since in Java and found the females to be, if anything, in the majority.

Both these species of *Delias* were commonly seen flying over mangrove swamps.

20. B 9–2 γ. **Cepora nerissa dapha,** M

21. B 9–3 γ. **Cepora nadina nadina,** Luc.

Nerissa common, *nadina* not rare. DSF Jan and Feb; WSF June.

22. B 10–5 γ. **Appias lyncida hippoides,** M.

23. B 10–6 β. **Appias albina darada,** Fd.

24. B 10–7 γ. **Appias paulina adamsoni,** M.

The DSF of *lyncida* was common in January and February. *Albina* and *paulina* occurred earlier, from November onwards, but were never very common. The WSF *Appias* had not appeared in Arakan by June 11th, but I saw them in Rangoon later on in the month.

25. B 11–1. **Catopsilia crocale,** Cr.

Very common, but was not seen at all in the dry weather. A mass emergence took place in Ramree Island on April 1st.

26. B 11–2. **Catopsilia pomona,** F.

27. ♀ v. **catilla,** Cr.

28. ♀ v. **bidotata,** Fruh.

Appeared only in the dry season. *Bidotata* is a distinct form, differing from *catilla* in having two quadrate, purple, sub-costal patches unh instead of the extensive purple blotches covering a large part of the wing.

In this area *pomona* may quite possibly be the DSF of *crocale*.

29. B 11–4. **Catopsilia pyranthe minna,** Herbst.

30. B 11–5. **Catopsilia florella gnoma,** F.

Both very common in the coastal scrub. *Florella* most in evidence from November to January.

31. B 15–4 α. **Eurema blanda silhetana,** Wall.

32. B 15–5 γ. **Eurema hecabe hecabe,** L.

33. B 15–6. **Eurema lacteola sarinoides,** Fr. (*Eurema simulatrix sarinoides,* Fruh.)

E. libythea and *E. laeta* were not recorded. *Blanda* was common, but only locally. I have taken several dwarf *hecabe* from various localities from Calcutta to Rangoon. Expanse 30 to 32 mm. There appears to be nothing intermediate between these and the normal butterfly which has a span of at least 40 mm. One aberration of *hecabe* was found, having a dark streak from end cell under the scv unh, the streak being about 3 mm. long.

I took one ♀ of *E. simulatrix sarinoides,* Fruh., in Ramree. It was sent to Brigadier Evans who has confirmed the identification. There is no female in the British Museum and this specimen has therefore been sent to Brigadier Evans for inclusion in the B.N. collection.

34. B 17–2 η. **Ixias pyrene latifasciata,** But.

Locally common.

35. B 19–γ. **Hebomoia glaucippe glaucippe, L.**

DSF common down to sea-level in January and February, but fewer occurred from March to June. The WSF appeared in Rangoon at the end of June.

36. B 20–3. **Pareronia valeria hippia, F.**

Common. Generally smaller than indicated by Evans; 62 to 75 mm.

DANAIDAE.

37. C 2-2. **Danais agleoides**, Fd.

A single male taken in Ramree, March.

38. C 2–9. **Danais limniace mutina**, Fruh.

39. C 2–11 α. **Danais gautama gautama**, M.

40. C 2–12. **Danais plexippus**, L.

41. C 2–13 α. **Danais melanippus indicus**, Fruh.

42. C 2–15. **Danais chrysippus, L.**

All fairly common except *gautama* of which I have only one male taken at Teknaf in December.

43. C 3–1 β. **Euploea mulciber mulciber, Cr.**

Common.

44. C 3–2α. **Euploea alcathoe doubledayi, Fd.**

One pair from Ramree Island in June.

45. C 3–7 δ. **Euploea core layardi**, Druce.

Not rare.

46. C 3–8. **Euploea godarti**, Lucas.

47. v. **plain apex upf.**

The commonest *Euploea* in the area. The variety with a plain apex upf was also common, but only males were seen.

48. C 3-10α. **Euploea deione deione**, Wd.

49. C 3–15 β. **Euploea diocletiana diocletiana**, F.

50. C 3–17 β. **Euploea klugii klugii**, M.

51. C 3–18 γ. **Euploea crassa crassa**, But.

Diocletiana and *klugii* not rare but local, particularly the former. I found no female *diocletiana* at all. I have one male *deione* from Teknaf, December. Although all species occur on the mainland and in the mangrove country, the numbers and variety on the islands are much restricted.

SATYRIDAE.

52. D 2–9 β. **Mycalesis perseus blasius**, F.

53. D 2–10 β. **Mycalesis mineus mineus**, L.

54. D 2–12 β. **Mycalesis visala neovisala**, Fruh.

Perseus and *mineus* were both locally common. The DSF appeared in November and the WSF at the beginning of June. A single male *visala*, WSF, was taken on Ramree Island in June.

Two very tattered WSF males of *mineus*, obvious survivors from the previous year's brood, were taken on 8th March when they would be at least five months old.

55. D 3–22 γ. **Lethe rohria rohria**, F.

I found this insect only on the bamboo-covered eastern slopes of Kalein Taung, a small hilly island to the east of Ramree.

56. D 14–11 β. **Ypthima hubneri hubneri**, Kirby.

57. D 14–15 γ. **Ypthima baldus baldus**, F.

Both common, the seasonal forms appeared with those of *Mycalesis.*

58. D 16- β. **Orsotrioena medus medus**, F.

Not common. WSF from June.

59. D 22–1. **Melanitis leda ismene**, Cr.

There appeared to be considerable overlap of the seasonal forms. Fresh DSF insects were appearing in June when the WSF was already to be seen in abundance.

60. D 25–1 γ. **Elymnias hypermnestra undularis**, Drury.

Male common, female rarely seen.

NYMPHALIDAE.

61. E 10–1 β. **Discophora tullia zal**, Wd.

In thick jungle, especially where there is bamboo. I have observed these butterflies from a distance of a few inches, but never managed to catch one.

62. F 1–2 δ. **Charaxes polyxena hierax**, Fd.

63. F 2–2 γ. **Eriboea athamas athamas**, Dr.

Not rare in the dry season, *polyxena* the rarer of the two.

64. F 18–3 γ. **Euthalia lepidea sthavara**, Fruh.

65. F 18–7 α. **Euthalia jahnu jahnu**, M.

66. F 18–14 η. **Euthalia garuda garuda**, M.

Euthalia were never very common, except for *garuda,* which was common in Ramree Island, February. *Jahnu* was found only in the jungles near Cox's Bazaar.

67. F 19–3. **Adolias dirtea jadeitina**, Fruh.

I found two males on a jungly path near a hill top on Ramree in June. They were both very old specimens, just enough left of them for me to effect an identification.

68. F 20–γ. **Parthenos sylvia gambrisius**, F.

Locally common. The brood was new in November, and no new specimens appeared after January. In one nullah near Teknaf it frequently came to the water to drink from the mud and bask on the stones.

69. F 21–γ. **Lebadea martha attenuata**, M.

Not rare. Very little different from the description given by Evans for *L. martha ismene,* Db & Hew.

70. F 24–7 γ. **Limenitis procris procris**, Cr.

Not rare in evergreen country.

71. F 25–2 α. **Pantoporia nefte inara**, Db.

72. F 25–3. **Pantoporia cama**, M.

Neither very common and extremely local.

73. F 26–1 β. **Neptis columella ophiana**, M.

74. F 26–2 β. **Neptis jumbah jumbah**, M.

Both common.

75. F 26–6 β. **Neptis hylas astola**, M.

76. F 26–6 γ. **Neptis hylas adara**, M.

Both races occur on Ramree island, although the general one is *adara* which also occurs down the coast. The contrast between the golden ochreous underside of *adara* and the ferruginous brown of *astola* is very noticeable.

77. F 26–7 β. **Neptis soma soma**, M.

78. F 26–8 β. **Neptis nandina susruta**, M.

Both found at Teknaf in December. Both rather rare, particularly *soma*.

79. F 26–32 β. **Neptis hordonia hordonia**, Stoll.

Common.

80. F 30–1. **Hypolimnas missipus**, L.

81. F 30-2. **Hypolimnas bolina**, L.

Neither very common except for the female of *bolina* which was much in evidence just before the rains. The male *bolina* rarely seen.

82. F 31. **Yoma sabina vasuki**, Doh.

Not rare. Fond of rocky nullahs and generally seen near water or in bamboo jungle.

83. F 33–γ. **Doleschallia bisaltide indica**, M.

Quite a common butterfly, but very difficult to catch owing to its habit of flying off into the thickets as soon as disturbed.

84. F 35–1 β. **Precis hierta magna**, Evans.

85. F 35–3 γ. **Precis lemonias lemonias**, L.

86. F 35–4 α. **Precis almana almana**, L.

87. F 35–5. **Precis atlites**, L.

88. F 35–6 γ. **Precis iphita iphita**, Cr.

All widely distributed. In addition to *almana* and *iphita*, the others also show marked seasonal variation. The WSF appears in June. I have not seen *P. orithya* anywhere between Calcutta and Rangoon.

89. F 41–γ. **Cupha erymanthis lotis**, Sulz.

90. F 42–1. **Atella phalanta**, Drury.

91. F 43–β. **Issoria sinha sinha**, Koll.

All are found together, especially on Lantana. *Sinha* is rather less common than the others.

92. F 45–1. **Cirrochroa fasciata**, Fd.

93. F 45–3 α. **Cirrochroa tyche mithila**, M.

Fairly common inhabitants of shady jungle paths and nullahs.

94. F 47–3. **Cethosia cyane**, Drury.

Not rare, but I did not see any after mid-December.

95. F 49–1 γ. **Ergolis ariadne pallidior**, Fruh.

96. F 49–2 δ. **Ergolis merione assama**. Evans.

Both locally common throughout the year.

ERYCINIDAE.

97. G 2. **Zemeros flegyas indicus**, Fruh.

98. G 4–5 γ. **Abisara echerius angulata**, M.

Always to be found flitting around jungle paths and clearings.

LYCAENIDAE.

99. H 5–3. **Gerydus boisduvali assamensis**, Doh.

100. H 8–α. **Spalgis epius epius**, Wd.

Not rare.

101. H 11–1 α. **Castalius rosimon rosimon**, F.

102. H 11–2 β. **Castalius caleta decidia**, Hew .

103. H 11-3 α. **Castalius ethion ethion,** Db & Hew.

Not rare. Mostly from November to January. *Rosimon* widely distributed but the others rather local.

104. H 13. **Syntarucus plinius,** F.

105. H 23-α. **Chilades laius laius,** Cr.

May and June, Common.

106. H 24-4. **Zizeeria lysimon,** Hub.

107. H 24-6 β. **Zizeeria otis otis,** F.

Common. The only two *zizeeria* seen.

108. H 25-1. **Euchrysops cnejus,** F.

109. H 25-3 β. **Euchrysops pandava pandava,** Hors.

110. H 26-1 α. **Lycaenesthes emolus emolus,** God.

111. H 27-1. **Catachrysops strabo,** F.

112. H 27-2. **Catachrysops lithargyria,** M

113. H 28. **Lampides boeticus,** L.

114. H 29-1 α. **Jamides bochus bochus,** Cr.

All common and widely distributed except *lithargyria,* which was rather rare.

115. H 29-4. **Jamides cleodus pura,** M.

116. H 29-5 β. **Jamides celeno celeno,** Cr.

117. H 29-9 β. **Jamides alecto eurysaces,** Fruh.

The wet season broods cover most of the year. I have seen them as late as December and they appeared on Ramree Island early in March. DSF form December to April. *Cleodus* and *alecto* not rare, but only occur in the jungles, unlike *celeno.*

118. H 32-3 α. **Nacaduba hermus nabo,** Fruh.

119. H 32-8 β. **Nacaduba curava euplea,** Fruh.

120. H 32-15 α. **Nacaduba nora nora,** Fd.

All fairly common.

121. H 44-1. **Curetis thetis,** Drury.

Teknaf, November and December.

122. H 46-1 δ. **Horsfieldia anita arracana,** GrS.

Not rare, November to January.

123. H 49-28. **Amblypodia khamti,** Doh.

Cox's Bazaar.

124. H 49-32 α. **Amblypodia agaba aurelia,** Evans.

125. H 49-32 β. **Amblypodia agaba agaba,** Hew.

These two races overlap in Ramree Island. *Aurelia* flying to the north, *agaba* to the south.

126. H 49-36 γ. **Amblypodia centaurus centaurus,** F.

127. H 49-39 β. **Amblypodia amantes amatrix,** De N.

Centaurus was very common at all times along the coast. *Amantes* occurred with it, but was never so common.

128. H 53-γ. **Loxura atymnus continentalis,** Fruh.

Locally common. DSF November to February; WSF end of May onwards.

29. H 57-12. **Spindasis syama peguanus,** M.

130. H 57–13 β. **Spindasis lohita himalayanus**, M.

A new brood of *lohita* appeared at the end of February. It lasted only four or five days as a host of lizards immediately set to work to pick them off the Mimost bushes on which they were wont to sit. Their lobes and tails had afforded a certain measure of protection, judging by the number of insects I saw with these parts neatly removed with a lizard's bite. *S. lohita* seemed to be preferred to *Lycaenesthes emolus* which commonly fed off the same bushes. *S. syama* not rare.

131. H 60–8. **Tajuria melastigma**, De N.

A single male taken at Kyaukpyu, February.

132. H 70–γ. **Cheritra freja freja**, F.

Rare. I have one specimen from Cox's Bazaar in January and one from Ramree in March.

133. H 80–3 α. **Hypolycaena erylus himavantus**, Fruh.

134. H 83–1 α. **Deudoryx epijarbas amatius**, Fruh.

135. H 85–15 α. **Rapala pheritimus petosiris**, Hew

136. H 85–14α. **Rapala dieneces dieneces**, Hew.

137. H 85–17. **Rapala jarbas**, F.

I have taken all these butterflies from the same clump of bushes at Kyaukpyu in Ramree Island. None of them are very common anywhere along the coast.

138. H 87–β. **Bindahara phocides phocides**, F.

Two males on Ramree Island, in a jungle clearing, early June.

HESPERIIDAE.

139. I 1–7 β. **Hasora badra badra**, M.

140. I 1–15 β. **Hasora taminatus bhavara**, Fruh.

141. I 1–16. **Hasora alexis alexis**, F.

Occur together in the scrub near the sea shore.

142. I 2–2. **Ismene mahintha**, M.

143. I 5. **Badamia exclamationis**, Fab.

Not rare.

144. I 14–3 β. **Tagiades obscurus meetana**, M.

145. I 14–5α. **Tagiades atticus khasiana**, M.

Common in palm groves and under the banks of muddy pools.

146. I 21–3 α. **Sarangesa dasahara dasahara**, M.

Ramree Island. Locally common.

147. I 25–1. **Odontoptilum angulata sura**, Fd.

Teknaf, uncommon.

148. I 42–1. **Ampittia dioscorides**, F.

149. I 43–9. **Aeromachus pygmaeus**, F.

150. I 46–2 β. **Iambrix salsala salsala**. M.

151. I 51–α. **Sancus pulligo subfasciatus**, M

152. I 57–2. **Udaspes folus**, Cr.

All common except *pygmaeus* which was not often seen.

153. I 59–1 β. **Gangara thyrsis thyrsis**, F.

Not rare. Generally flies very early in the morning or at dusk.

154. I 64–1. **Matapa aria**, M.

155. I 77–1. **Unkana attina**, Hew.

Not rare. Evans gives 'Bassein' as the farthest north that *attina* flies.

156. I 91–1 α. **Astycus augias augias**, L.

157. I 91–2 β. **Astycus pythias bambusae**, M.

Both common.

158. I 97–24 β. **Baoris conjuncta javana**, Mab.

159. I 97–33 β. **Baoris zelleri cinnara**, Wallace.

There were several other *Baoris* that I did not catch or identify. *Conjuncta* was not rare, zelleri common.

ANALYSIS

Number of species and forms, excluding seasonal forms, found to occur in the area:—

Papilionidae.	15
Pieridae.	21
Danaidae.	15
Satyridae.	9
Amathusiidae.	1
Nymphalidae.	35
Erycinidae.	2
Lycaenidae.	40
Hesperiidae.	21
Total	159

A NEW PEST OF SUGARCANE IN INDIA—*ICERYA PILOSA NARDI* GREEN (*COCCIDAE*).

(*With two plates.*)

BY

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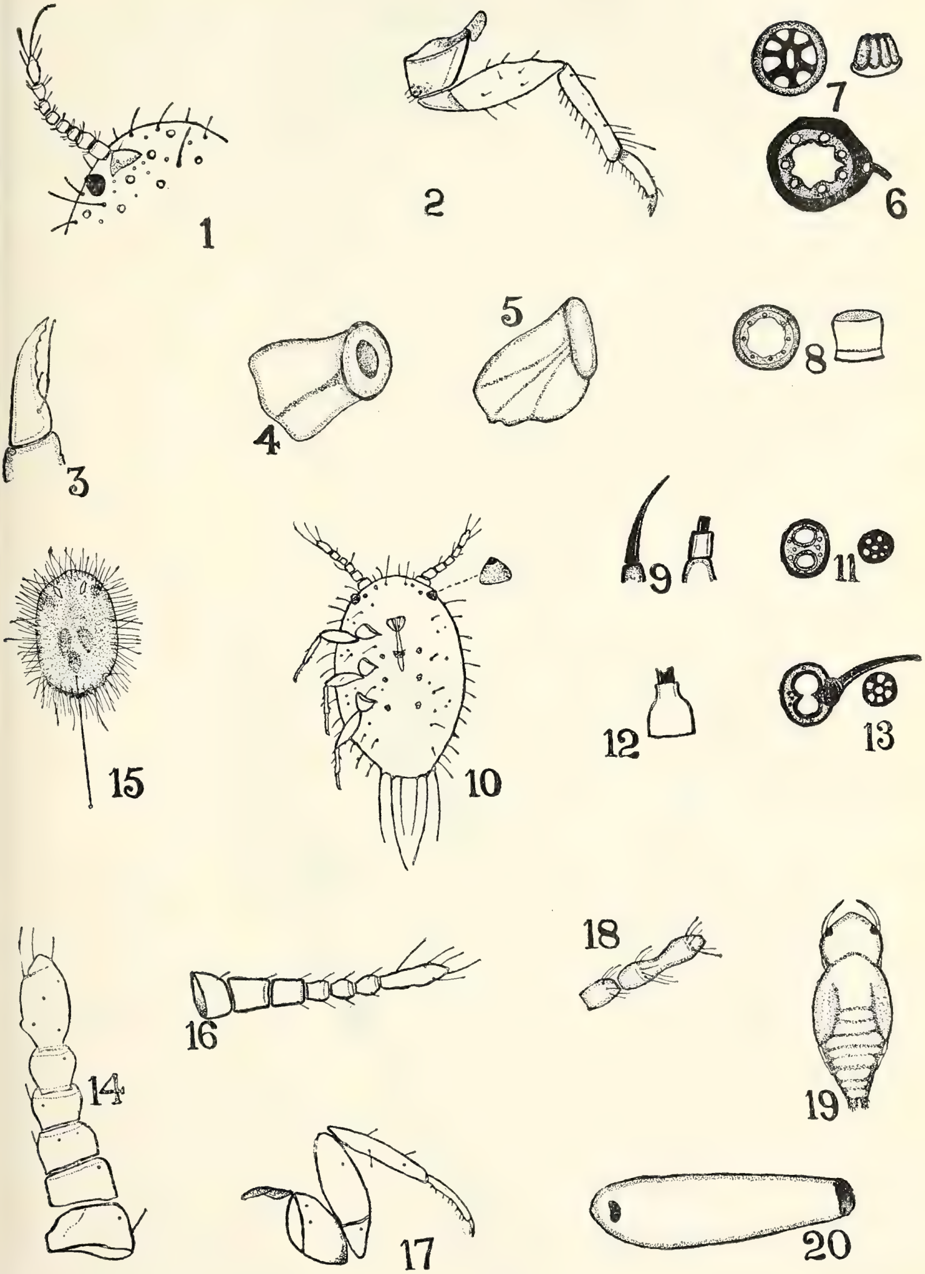
INTRODUCTION.

While engaged in the study of the pests of sugarcane under the Imperial Council Scheme for Research on Insect Pests of Sugarcane, the writer came across a large mealy-bug doing considerable damage to very young sugarcane seedlings at Coimbatore, South India. Specimens were identified as *Icerya pilosa nardi* Green. The species was originally described by Green (1922) as *Icerya seychellarum* var. *nardi* from 'a single specimen found on mana grass (*Andropogon nardus*) on uncultivated land at Diyatalawa, Ceylon', and later on regarded it as *Icerya pilosa* var. *nardi* (1937). This is the first record of the species from the mainland of India and mentioned by Isaac (1937) as noticed for the first time on sugarcane in India. Since then a number of coccids including the above one, attacking sugarcane in India, are listed by Pruthi and Rao (1942).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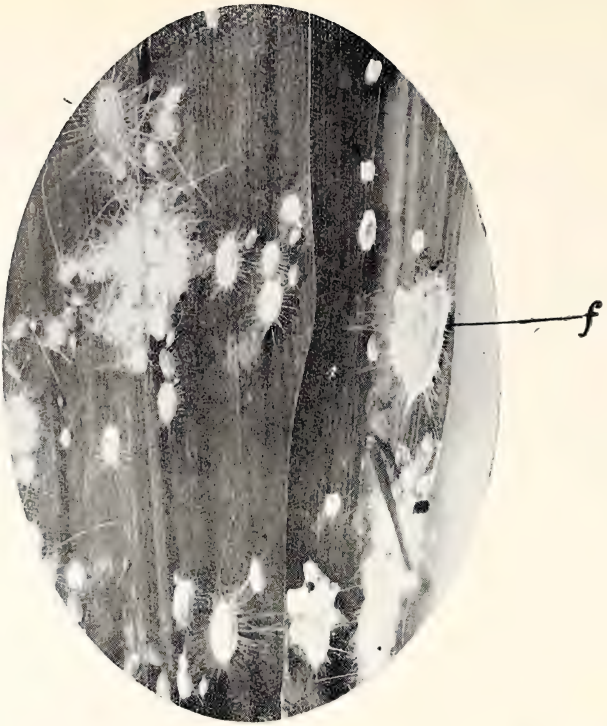
Icerya pilosa nardi Green.
(For explanation see end of article.)



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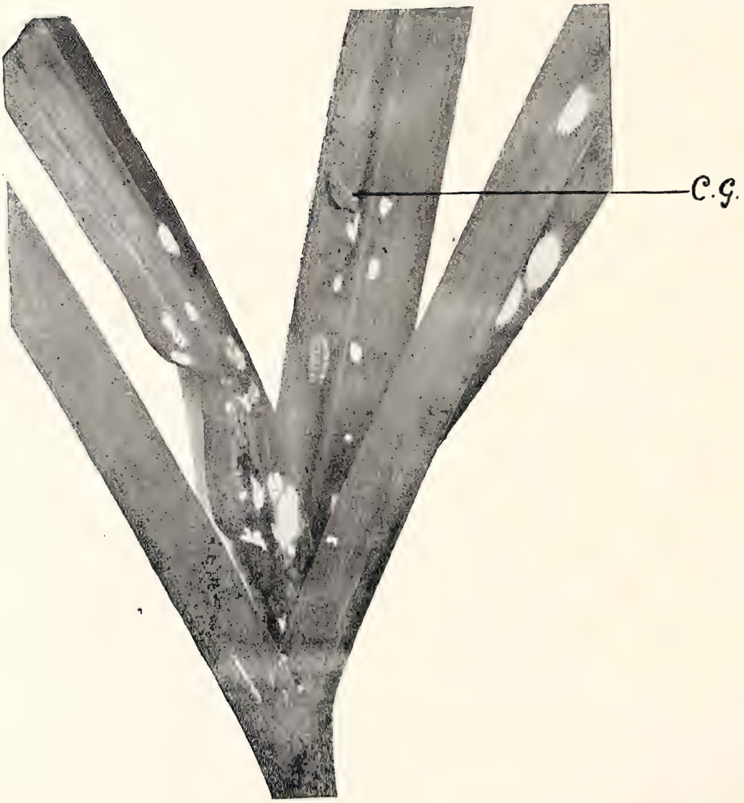

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Icerya pilosa nardi Green.
(For explanation see end of article.)

NATURE OF DAMAGE, FOOD PLANTS, AND DISTRIBUTION IN INDIA.

The pest was first noticed on young sugarcane seedlings in all stages of development, mostly on the under surface of leaves. The nature of the injury caused is the extraction of the sap and the consequent weakening of the plant. In the case of very young seedlings, the leaves turn yellowish and the plants invariably die.

The choice of the food plant by this insect appears to be limited within the family Graminae. In addition to sugarcane it is found attacking *Saccharum spontaneum* in Coimbatore and *S. ravennae* Linn., in New Delhi.

This mealy-bug is recorded from Delhi, Karnal, Meerut and Coimbatore.

MORPHOLOGICAL NOTES

THE FEMALE

First-stage nymph (Pl. I, figs. 10-12).

It is more or less oval and brick red in colour. The dorsum has a thin coating of waxy secretion. The limbs and antennae are well developed and greyish in colour. The antenna is six-segmented, the terminal being the longest. There are two kinds of ceriferous pores on the dorsum; six bilocular pores along the median line and numerous small multilocular pores distributed all over the dorsum. There are six long setae with well developed collars in the anal region. The first pair of spiracles alone are present at this stage. Length 0·6 mm. to 0·7 mm.

Second-stage nymph (Pl. I, figs. 13-15).

The antennae are stouter, the first, second and third segments are thick and the rest are basally constricted. The terminal segment shows a distinct division making it seven-segmented. The bilocular pores found in the first stage loose the central partition and become unilocular, highly chitinised, and each pore bears a seta. The multilocular pores increase in number. Length 1·8 mm. to 2·0 mm.

Third-stage nymph (Pl. I, figs. 16 and 17).

This stage resembles the adult female in all respects except in size. The antenna is distinctly seven-segmented and all the segments are provided with long hairs. Both the pair of spiracles are present, the anterior being irregular in shape. The tibia is slightly arched. The tarsal claw is long and provided with two denticles on the inner surface. The anal ring is heavily chitinised. Length 2·7 mm. to 2·9 mm.

Adult female (Pl. I, figs. 1-9 & Pl. II, fig. 1).

The adult female, just before gestation is quite red in colour. The dorsum is highly convex with a dense coating of white meal. Long waxy filaments are present all over the dorsum, which are more numerous towards the posterior end. The posterior extremity carries a brush of stout mealy processes. The limbs and antennae are dark red in colour. Length 4·9 mm. to 9·9 mm; breadth 2·4 mm. to 3·8 mm.

The species resembles *I. pilosa* Gr., in all morphological characters except in its larger size and in the possession of distinctly serrate claws. Green (1937) thinks that 'it may eventually prove to be a distinct species'.

THE MALE

The first and second instars are similar to those of the female.

Third-stage nymph.

Sex differentiation takes place soon after the second moult. The male nymphs at this stage are distinguished from those of females by the longer abdomen.

Fourth-stage nymph.

At this stage the male is very much elongated and the head is clearly marked out from the rest of the body. The wing pads also have made their appearance. The anal end of the abdomen is prominently bilobed and fleshy. The body is practically devoid of any mealy secretion. Length 3·1 mm. to 3·4 mm.

Pupa (Pl. I, fig. 19).

The pupa is distinguished by the presence of prominent wing pads and well developed anal appendages. The antennae are also very much elongated. Length 3·0 mm. to 3·2 mm.

Male cocoon (Pl. I, fig. 20).

The cocoon is elongated and loosely constructed of waxy filaments. It is partially open at the posterior end. Length 8·0 mm. to 9 mm.

Adult male (Pl. I, fig. 18)

The male is reddish in colour with a thin coating of white meal; eyes dark red in colour and very prominent. The antenna is ten-jointed and with bi-nodose joints. The abdomen is provided with a pair of fleshy appendages, each carrying 6 to 7 long setae. Length 2·7 mm. to 3·7 mm.

MATING, EGG-SAC FORMATION AND OVIPOSITION.

Males are very much fewer in number than the females. The male, soon after emergence, wanders about for some time before it selects a female for copulation. The whole process of copulation lasts from 4 to 6 minutes. A single male was observed to copulate with more than one female during the course of one hour.

Although copulation was observed in a few cases parthenogenesis appears to be the usual mode of reproduction as in other Iceryine coccids. Hughes-Schrader (1930) has studied in detail the life-history of some Iceryine coccids and has concluded that parthenogenesis is characteristic for the genus as a whole. She thinks that 'copulation may occur between the hermaphrodites and the occasional males but it is no wise for reproduction.'

The adult female, before gestation, anchors itself near the base of the leaf and from the pores of the ventral band the waxy threads begin to issue to form the ovisac. The ovisac so formed remains partially covered under the posterior waxy processes of the female. Oviposition commences as soon as the lower layer of the ovisac is formed, the female continuing to lay eggs for about three weeks. In the laboratory a total of 49 eggs were laid by the largest female, a smaller one laying 32 eggs.

LIFE-HISTORY.

The first young hatched in about a week after the formation of the lower layer of the ovisac. The average duration of the egg stage was found to be 9 days. The newly-hatched nymph remains inside the ovisac for some time before it comes out. The earliest first moult occurred 17 days after the first egg had hatched. The average duration of this instar was found to be 19 days. In moulting, a small cleft appears at the anterior end of the nymph and it slowly makes its way out, dragging the body, the whole process lasting from 4 to 5 hours. The earliest second moult occurred 16 days after the first moult; the average duration of the second instar was 21 days.

Sex differentiation takes place in the third instar. The average duration of the third instar of the female was found to be 18 days. The total average duration of the life-cycle of the female was 102 days. The third-instar larva of the male crawls about for some time and finally goes under the leaf-sheath to spin the cocoon. In this cocoon the third and the final moult, before it enters the pupal stage, are undergone. The average duration of the third instar of the male was found to be 16 days and that of the fourth instar 8 days. The male lived for 2 to 4 days. The average duration of the life-cycle of the male was 84 days.

TABLE.

Summary of the Life-history of Icerya pilota nardi Green.

Stage	Average length in days		Number of individuals involved	
	Males	Females	Males	Females
Egg stage	9	9	8	33
First-instar	19	19	8	33
Second-instar	22	21	8	33
Third-instar	16	18	6	27
Fourth-instar	8	Stage not present	5	...
Pupa	7	Do.	4	...
Adult				
Pre-oviposition period ...	Stage not present	12	...	18
Oviposition period ...	Do.	23	...	
Period after emergence to death	3	Stage not present	5	...
Total average life-history period	84	102	44	144

Natural Enemies (Pl. II, fig. 2).

The grubs of the lady-bird beetle, *Novius guerini* Crotch were found feeding on all stages of *Icerya* and checking the spread of the pest to some extent. The grubs rupture the dorsum of the nymphs with their large mandibles and feed on the body contents. In the case of older nymphs as many as 3 to 4 grubs were found to attack a single specimen. The beetle grubs resemble the newly moulted nymphs of the mealy-bug and are easily mistaken for the nymphs. They are heavily parasitised by the encyrtid, *Homalotylus flaminius* (Dalm.), and thus reduce their value as economic factors in controlling the pest. Two species of ants are found to visit these mealy-bugs for the sake of their sugary excretion and these ants were sometimes observed to attack the beetle grubs that attack the coccids.

SUMMARY.

1. The habits and life-history of *Icerya pilosa nardi* Gr., a new coccid pest of sugarcane in India are described. This is the first record of the species from the mainland of India.

2. The female moulted twice before reaching maturity. The average time required for the different stages of the female were: egg stage 9 days, first-instar 19 days, second-instar 21 days, third-instar, before gestation 18 days, and post-gestation period 35 days. Total life-history 102 days. For males,

the incubation period, the first, and second instars were almost the same as in females. Third instar males, however, secreted a cocoon of loose wax in which the third and fourth instars and the pupal stage are passed. The total period inside the cocoon occupied, on an average, 31 days. The adult male had a maximum life of 4 days after emergence.

3. The grubs of a lady-bird beetle, *Novius guerini* Crot., were found feeding on all stages of *Icerya pilosa nardi* and checking the spread of the insect to a certain extent. The encyrtid, *Homalotylus flaminius* (Dalm.) was found parasitising the grubs of *N. guerini* in certain seasons, and thus reducing the value of the predators as economic factors in controlling the pest.

Thanks are due to Mr. P. V. Isaac, Second Imperial Entomologist, Agricultural Research Institute, New Delhi and to Mr. P. S. Negi, Entomologist, Indian Lac Research Institute, for kindly going through the manuscript and offering many helpful suggestions.

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EXPLANATION OF PLATES.

PLATE I.

Figure 1. Adult female, anterior end showing antenna, eyes & pore. ×32.
,, 2. Adult female, mid-leg. ×32.
,, 3. Adult female, claw. ×450
,, 4. Anterior spiracle adult, female. (Enlarged).
,, 5. Posterior spiracle, adult female. (Enlarged).
,, 6. Large pore (first type), adult female. (Highly magnified).
,, 7. Small pore (second type), one in profile, adult female. (Highly enlarged).
,, 8. Third type of pore, adult female, one in profile. (Highly enlarged).
,, 9. Long seta, adult female. (Highly magnified).
,, 10. First-stage larva. ×40.
,, 11. Ceriferous pores, first-stage larva. (Highly magnified).
,, 12. Anal seta, first-stage larva. (Highly magnified).
,, 13. Ceriferous pores, second-stage larva. (Magnified).
,, 14. Second stage nymph, left antenna. ×160.
,, 15. Second stage nymph, dorsal view. ×20.
,, 16. Third stage nymph, left antenna. ×160.
,, 17. Third stage nymph, mid-leg. ×40.
,, 18. Male, antennal joint. ×160.
,, 19. Male pupa. ×15.
,, 20. Male Cocoon. ×15.

PLATE II. (Photographs)

Photo 1. Insects on leaves, in situa. (Nat. size).
2. Novius grubs feeding on Icerya nymphs. (Nat. size).

Lettering.—f. Adult female with egg-sac.
c.g. Coccinellid grub feeding on nymphs.

Fig. 1. Game Warden, Punjab and Survey Staff.

Fig. 2. Survey Boat on River Indus.

A FISHERY SURVEY OF RIVER INDUS

BY

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(*With 3 plates.*)

To develop the fisheries intelligently and scientifically, survey of rivers in relation to the fisheries is a necessity. The main object of the survey is to acquire a reasonable knowledge of the conditions of fundamental importance in conserving the fisheries resources and the conditions affecting the marketing of fish.

River Indus is an uncontrolable river: in winter it dwindles to a size of an ordinary stream, but in summer as snow melts in the hills and monsoon rains commence, it becomes a vast stretch of water, expanding miles and miles in width, navigable by steamer at Dera Ismail Khan and Dera Ghazi Khan. At present it is navigable throughout its length in the Punjab in winter, whether it will remain so in the years to come is difficult to say, as the Head-works of Thal Project have been completed and the river will partly be diverted into the canal early next winter. The river changes its bed practically every year. Not a single map out of the four that we had with us represented the present state of the river. A year ago the river was miles away from Isa Khel, now it flows under its skirts. Similarly at Dera Din Panah the river has diverted its course entirely to the west.

The survey was undertaken jointly with the staff of Board of Economic Enquiry, Punjab, (Fig. 1) comprising of an Investigator and two Fisheries Recorders and the journey down the river was commenced on the 28th February, 1944, in a country boat (Fig. 2) in which a field Laboratory was fitted up, (Fig. 4). A stretch of about 250 miles from Kalabagh up to Guzar Qureshi (i.e. boat bridge on road to Dera Ghazi Khan) was surveyed in 14 days without any untoward incident. Weather was fair and river was in partial flood due to recent rains. Village officials on the way were quite helpful and gathered in number to listen to our fishery development programme when a halt was made (Fig. 3).

Game on the river was in fair abundance. Ducks were rather fewer as they were on their return journey to their summer abodes. The species of duck seen were Mallard, Tufted Pochard and Common Teal. Bar-headed geese were seen in good number and so were various waders.

FISHERIES OF RIVER INDUS

Fishery Revenue.—The portion of river Indus surveyed lies within the jurisdiction of three districts, namely, Mianwali, Muzaffargarh and Dera Ghazi Khan. The fisheries of these districts are leased out annually to the highest bidder from September to August. The receipts for the year 1943-44 were as under:—

District		*Tahsil*	*Amount* Rs.	*Total* Rs.
Mianwali	...	Mianwali	2,500	7,100
		Isa Khel	1,500	
		Bhakkar	3,100	
Muzaffargarh	...	Muzaffargarh (Indus)	1,100	3,500
		Leiah (Indus)	500	
		Kot Adu	1,900	
Dera Ghazi Khan	...	Dera Ghazi Khan	600	2,105
		Jampur	150	
		Rajanpur	1,255	
		Sanghar	100	
			Grand total	12,705

Fishermen.—The contractors engage local fishermen to catch the fish. From 400 to 500 fishermen are usually engaged by the contractors for fishing in the tract surveyed. These fishermen (Fig. 6) are mainly low caste menials such as Muselies (sweepers) Jullahas (weavers) or Mohanas (Mallahs) and the Mochies (cobblers). Occasionally Zamindars, Qureshies or Pathans take up the profession as an exception. In off season the fishermen do sowing and harvesting. The fishermen are not paid daily wages but get two-third of the share of the fish caught from the contractor and the latter gets 1/3 share only. Fishermen sell their share to the contractor usually at the rate of Rs. 14 to Rs. 20 per maund.

Fishing areas.—The fishing is mainly done in side streams, nallas, dhands or in creeks of the river. Fishermen allege that during winter most of the fish are to be found in the creeks and side streams for the reasons that (i) temperature of the river water in winter is cold while that of the creeks is warm and water there is shallow, and that (ii) the creeks and dhands are full of food and afford good feeding ground to the fish. There is some truth in it. Record of temperature shows that the water in dhands is decidedly warmer than that of the river and it was observed that dhands had plenty of aquatic weeds such as *Chara* and *Vallisneria* and quite a number of crustacea.

These dhands appear to be the spawning grounds of fish as numbers of fry were seen in them. The fish spawn in July and August when river is in flood and ascend side streams and creeks to lay their spawn in shallow water. When the floods subside some of the adult fish take up their abode in these creeks and streams while others find their way to the main stream.

The creeks and dhands are not permanent fixture but change every year with the vagaries of the flood and are usually known by the name of the village or town near which they are formed. Starting from Kalabagh, the names of dhands, creeks and offshoots of the main channel, upto Guzar Qureshi or Boat Bridge on road to Ghazi Ghat, fished during the year 1943-44 together

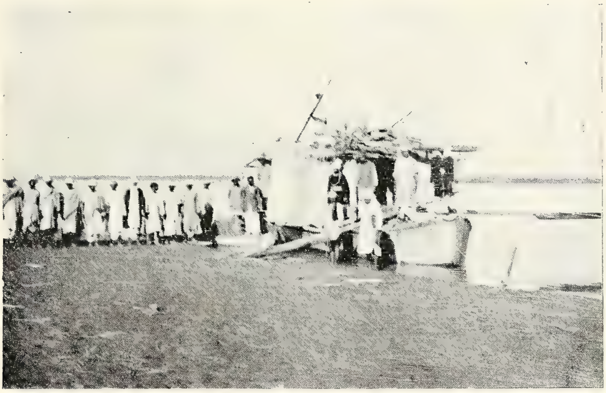

Fig. 3. Village Officials and Villagers *en route*.

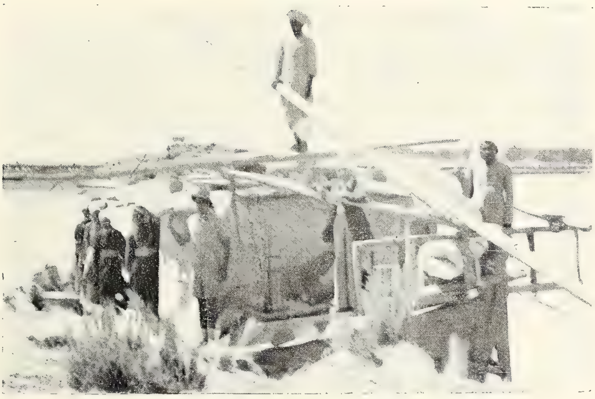

Fig. 4. Survey Boat with a Field Laboratory.

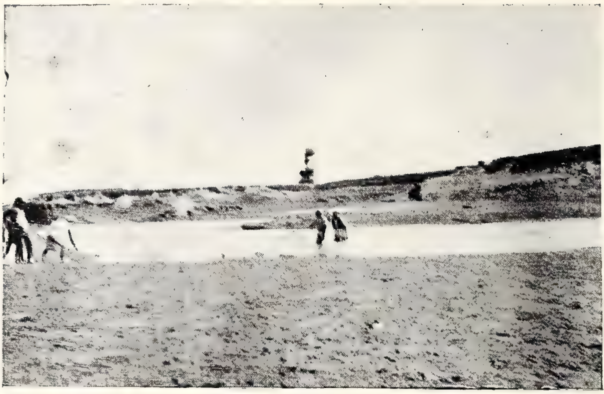

Fig. 5. Fishing with Drag Net in a dhand of River Indus.

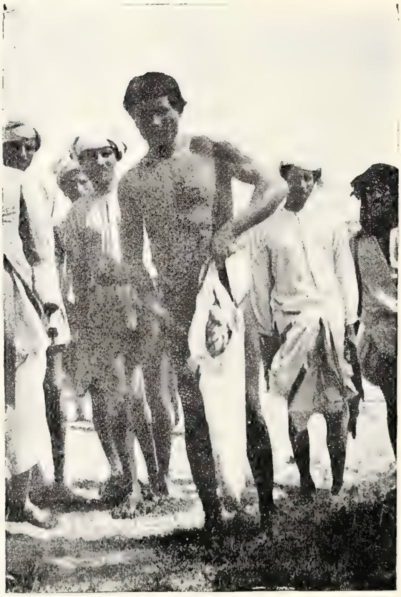

Fig. 6. Fishermen of Bhakar on River Indus with a Catfish (*Wallago attu*).

with the approximate catches of fish taken out from them from September, 1943, to February, 1944 are given in the table below. The figures given have been collected by Fisheries Recorders from the contractors.

The fisheries of the main river, thus, have not so far been exploited at all. The fishermen advance the following reasons for their inability to fish in main channel:—

(i) The main channel is too swift and too deep for their home made nets;
(ii) They are too poor to have sufficient number of boats to fish in the main channel;
(iii) The lease is annual and contractor is reluctant to invest any money for the enterprise.

Method of fishing.—Fishing nets and other implements are similar to those described by the Author in 'Methods of Fishing'[1], namely, Drag Nets, Casting Nets, Dip Nets or Kurli. The mesh of the net is 1½ in. square or 6 in. all round. The nets are the property of fishermen and so are the boats which are required for manipulating the nets. But the contractor often advances funds for their purchase or manufacture. Netting operations were observed in Langarwali dhand and also in Dhand Qureshi near Bhakkar. A stake net or banda is fixed at the lower end of the reach which is intended to be fished and drag nets are worked from upstream down towards the stake net and are taken out close to the stake net (Fig. 5). The catch in Dhand Qureshi which had already been fished four times consisted of 7 mullee, (*Wallagonia attu*) 1 singharee (*Mystus aor*) 1 mori (*Cirrhina mrigala*) and 1 kalbans (*Labeo calbasu*).

Species of fish and their distribution in the river.—Species of fish caught in Mianwali district in order of commercial importance are Mullee (*Wallagonia attu*), Mori (*Cirrhina mrigala*) Singhari (*Mystus aor*), Khaga (*Rita rita*) Rohu (*Labeo rohita*), Theila (*Catla catla*) and Saul (*Ophiocephalus marulius*). In Muzaffargarh and Dera Ghazi Khan districts, species of fish are practically the same but Mori comes first, next Mullee, then Rohu, Theila, Pari, Singhari and lastly Khagga. Saul is occasionally found. Jhalli (*Eutropiichthys vacha*) is also sometimes caught. Mahsir [*Barbus tor*) is not reported to have been caught below Kalabagh. Mullee (*Wallagonia attu*) (Fig. 6), a carnivorous catfish, is found in large numbers in the creeks and dhands probably due to the presence of fry in these waters on which these fish feed. Carp especially the big species, namely, Theila and Rohu are fewer in dhands than the catfish as they prefer deeper waters and would very likely be found in abundance in the main channel.

Food of fish.—Study of stomachs of Mullee (*Wallagonia attu*), showed that the fish mainly consumed small sized fish. Stomachs of Kalbans (*Labeo calbasu*) contained mud, algae and crustacea.

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[1] 'Method of fishing in the Punjab', *J.,B.N.H.S.*, xxxiv, 1930.

Productivity of the river Indus.—From the information collected by Fisheries Recorders from the contractors, approximate figures of catches for 1943-44 were as under:—

District	Tehsil	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
		Md Seer	Md Seer	Md Seer	Md Seer	Md Seer	Md Seer
Mianwali ...	Isa Khal	29—27	103—34	282—32	244—0	178—0	80—0
	Bhakkar	3—31	109—39	223—0	—	158—0	110—0
D. G. Khan	Sanghar	—	—	—	7—29	61—19	54—29
	D. G. Khan upto Guzar Qureshi	0—35	1—30	80—5	28—30	138—33	—
Muzaffargarh ...	Kot Addu	—	—	18—29	101—14	141—17	124—27
	Totals	34—13	215—23	604—26	381—33	677—29	369—16

Grand total ... 2,283 maunds 20 seers.

These figures do not include the catches below Guzar Qureshi.

Marketing of fish.—Fishing leases are auctioned in August and fishing commences from September. By the end of next March the creeks and dhands are almost completely fished of all the sizeable fish. The fry of fish escapes through the meshes of the nets. From April onward fishing practically ceases as fishermen have neither the capability to fish in the main channel nor facility to market the fish in summer. Fish from fishing centres is taken on camels to the nearest railway station and sent to the nearest markets, namely Mianwali, Peshawar, Rawalpindi, Campbellpur, Bannu, Razmak, Dera Ghazi Khan and occasionally to Jhelum. Railway line runs along the river Indus on one side from Kalabagh to Mahmud Kot and from there to Muzaffargarh and Multan and on the other side upto Isa Khel and then to Bannu. The freight charges are paid by the consignee, and the rate at which fish is marketed varies from Rs. 30 to Rs. 45 per maund. It is estimated that the contractors who paid Rs. 12,705 to Government for the annual lease, sold the two thousand and odd maunds of the fish taken out from dhands for not less than Rs. 75,000. Out of this sum the 400 or 500 fishermen, who were paid a low price for their share of catch got about Rs. 25,000 only i.e. Rs. 50 or Rs. 60 per fisherman for the year, which is a poor return for all the labour that he puts in.

Miscellaneous.—Record of air and water temperature was maintained daily. Air temperature ranged from 52°F. in the morning to 84°F. in the afternoon and water temperature from 54°F. to 68°F. in the river and from 66°F. to 72°F. in the dhands. Water in dhands was thus warmer than the river.

2. *Gaseous contents.*—Dissolved oxygen ranged from 4.5 cc. p.1 to 6.05 cc.p.1 and free Co_2 from 5.308 to 8.595 cc.p.1 in the

river and from 2.275 to 10.364 cc.p.1 in the dhands; fixed Co$_2$ from 29.324 to 30.841 cc.p.1 in the river and from 25.281 to 35.644 cc.p.1 in the dhands. The water was alkaline with pH value of 8.0.

3. *Enemies of Fish.*—Besides the carnivorous fish such as Mullee (Fig. 5) and Singhari, the river has large number of otters, crocodiles and cormorants and fish-eagles which are deadly enemies of fish. Study of stomachs of two cormorants showed that each had 4 fish, varying in size from 4 inches to 6 inches. One fish-eagle was seen on the bank of the river devouring a 4 pounder Mullee (*Wallagonia attu*).

4. *Canals.*—There is at present only one canal namely Chashmia canal, that is taken out from the river in the stretch surveyed and flows towards Dera Ghazi Khan district. It does not cause any obstruction to the free movement of fish as there is no weir. The Thal Project, however, has a weir but the river is not yet diverted to it.

CONCLUSION.

Fisheries of the River Indus are not fully exploited. The few maunds of fish which are taken out from the creeks and dhands represent a minor part of the main fisheries. The fishermen are too poor to adopt new methods of fishing. The contractor, as already remarked, is reluctant to invest any money to improve the conditions of fishermen as he gets an annual lease only and may be ousted by a higher bidder any year.

ACKNOWLEDGEMENT.

My thanks are due to the Chairman and Secretary, Board of Economic Enquiry, Punjab, for affording me facilities for the survey. The staff of the Board assisted me throughout the survey and supplied me with details of the figures collected by them from the various sources. The Investigator, Mr. A. Latieff, B.Sc., helped me in keeping the records of temperature and of gaseous contents of water.

SUMMARY.

1. Survey of River Indus from Kalabagh to Guzer Qureshi covering a stretch of about 250 miles was made by a country boat in 14 days.
2. The river is navigable throughout its length.
3. Fishing is done in side streams, creeks and dhands. The fisheries of the main river remain unexploited as the fishermen are too poor to invest any money in nets or boats suitable for river fishing.
4. The creeks and dhands are not permanent features and change every year with vagaries of flood. The dhands appear to be spawning grounds of fish. Their water is shallow and warmer than that of the river. They contain aquatic weeds and number of crustacea which serve as food to the fish.
5. Fishing is generally done by drag nets in conjunction with a stake net, casting net and dip net. The mesh of the net is 1½ inches square or 6 inches alround through which fry of fish escape.
6. Species of fish found are Mullee (*Wallagonia attu*) Mori (*Cirrhina mrigala*), Singhari (*Mystus aor*), Khaga (*Rita rita*), Rohu (*Labeo rohita*), Theila (*Catla catla*). Occasionally Saul (*Ophicephalus marulius*). Jhalli (*Eutropiichthys*

vacha) are also caught. Abundance of Mullee, a carnivorous fish, in creeks is probably due to presence of fry of fish in these waters on which the fish feed.

7. Figures collected from the contractors show that approximate catches from the river dhands during 1943-44 were about 2,284 maunds. The fish were sent from the nearest railway station to Mianwall, Peshawar, Campbellpur, Rawalpindi, Bannu, Razmak, Dera Ghazi Khan and Jhelum. At present the lessees have no facilities to market the fish during the summer. The fishing, therefore, is restricted to winter.

8. Record of temperature and gaseous contents showed that air temperature ranged from 52 F. to 84°F. and water temperature from 54°F. to 68°F. in the river and from 66°F. to 72°F. in the dhands. Dissolved oxygen varied from 4.5 cc.p.1 to 6.05 cc.p.1 and free Co_2 was 5.308 to 8.595 cc.p.1 in the river and 2.275 cc.p.1 to 10.364 cc.p.1 in the dhands and fixed Co_2 was 29.324 to 30.841 cc.p.1 in the river and 25.281 to 35.644 cc.p.1 in the dhands. The water was alkaline with pH value of 8.0.

9. Besides the carnivorous fish such as Mullee and Singhari the river has a large number of otters, crocodiles and fish eagles which are the deadly enemies of fish.

LIST OF DHANDS TOGETHER WITH APPROXIMATE WEIGHT OF FISH TAKEN OUT

District	Dhand, creek or offshoot of the main channel	Approximate catch of the fish during 1943-4	Remarks
		Mds Seers	
Mianwali ...	Mandakhel ...	25—0	
	Kamar Mashani ...	30—0	
	Ganda ...	20—0	
	Adil Shah ...	80—0	
	Langarwali ...	20—0	
	Kundal ...	200—0	
	Kundian ...	10—0	
	Bhakhra ...	15—0	
	Alluwali ...	10—0	
	Doaba ..	50—0	
	Kunderwali ...	20—0	
	Piplan ...	600—0	
	Saggowali ...	60—0	
	Mosiwali ...	45—0	
	Kallurkot ...	85—0	
	Nun Nasheb ...	15—0	
	Bakhtawarwali ...	30—0	
	Lyianwali ...	10—0	
	Maibal ...	10—0	
	Kalulwali ...	20—0	
	Shahalam ...	10—0	
	Ahmed Shahwali ..	—	
	Panj Girian ...	10—0	
	Kirari Nun ..	20—0	
	Lakanwali ...	20—0	
	Abdullah Shahani ...	80—0	
	Laduwali ...	10—0	
	Kotlajam ...	10—0	
	Qureshi ...	14—0	
	Dilkhushab ...	10—0	
	Chunchawali ...	20—0	
	Carried over ...	1,559—0	

LIST OF DHANDS TOGETHER WITH APPROXIMATE WEIGHT OF FISH TAKEN OUT—(*Cont.*)

District	Dhand, creek or offshoot of the main channel	Approximate catch of the fish during 1943-4	Remarks
		Mds Seers	
	Brought forward ...	1,559—0	
	Bhakkarwali ...	15—0	
	Notak ...	20—0	
	Behal ...	25—0	
Muzaffargarh ...	Khanpur ...	20—0	
	Karor ...	20—0	
	Darotta ...	15—0	
	Jhoke Hasanwali ...	5—0	
	Naiwali ...	25—0	
	Phat lala ...		Private waters
	Phat Shiemar ...		
	Badu ...		
	Kas Baroda ...		
	Kas Jharband ...		
	Phat Mirani ...		
	Khandar ...		
	Budhan ...		
	Langha ...	15—37	
	Daera Din Panah ...	386—7	
Dera Ghazi Khan...	More Jhangi ...	65—26	
	Ghali ...	9—10	
	Taunsa ...	33—4	
	Lunwali ...	—	
	Shahdanlund ...	—	
	Mochiwali ...	—	
	Kala ...	130—33	
	Shah Sadar Din ...	—	
	Pir Adil Shah ...	41—30	
	Laddan ...	60—20	
	Badani ...	8—5	
	Drahma ...	9—5	
	Total ...	2,464—17	

Note.—These figures do not tally with the monthly figures of catches collected from contractors given in the text, because the fishermen do not keep a regular record of their catches.

REVIEW

FAUNA OF BRITISH INDIA, Reptilia and Amphibia, Vol. iii, Ophidia 2nd Edition. By Malcolm A. Smith, Taylor and Francis, Red Lion Court, Fleet Street, London.

The first thing to strike one on comparing this book with its predecessor (F.B.I. Reptilia & Batrachia—Boulenger 1890) is the illustrations—improved both in quantity and quality. Mere numbers understate the case (166 against 58) because many of the new text-figures occupy a full page—some of them two. It was, perhaps, a pity to have reproduced only one (on p. 77) of the original nine drawings illustrating the general appearance of one complete snake from each of the main groups. All the new figures have been most helpfully chosen; for example three of them are in half-tone from photographs where that medium was obviously better suited to the subject. In addition to showing shields and scales the new line-drawings indicate the pattern in stippling and black—a great help because, however untrustworthy a guide *colour* may be where snakes are concerned, the arrangement of the colours, the *pattern,* is nearly always a sound one. I can only find one, very trivial, criticism of the new figures—the severe profile on page 364 of the old book is a more 'speaking likeness' of *Psammodynastes pulverulentus* than that on page 369 of the new—but text-figures are diagrams rather than portraits and this particular snake happens to be an almost intimate acquaintance. Apart from this Miss E. C. Humphrey's work is above praise.

Amateur field-naturalists as a rule hate any innovation but I think the most conservative among us will welcome the arrangement of genera in this book as being far more natural than the old. Formerly one half of the "flying" snakes—*Dendrophis* and *Dendrelaphis* (now both *Ahaetulla*) were separated from the other half—*Chrysopelia*—by no lsss than eleven unrelated genera, merely because of some grooves on the last two or three maxillary teeth. These same grooves were responsible, under the older system, for separating our Bengal egg-eater (*Elachistodon*) from the African egg-eater which has the same ingenious mechanism in its throat for puncturing eggs. It is interesting to find that, had the older systematists examined the last two maxillary teeth of the then *Tropidonotus ceylonensis* (Boulenger, p. 346) instead of assuming the absence of grooves, they would have had to remove this snake far away from all other Keelbacks and place it somewhere among the Opisthoglypha. It is now in a genus of its own (*Balanophis*) but comes between *Natrix* and *Pseudoxenodon*—two good Keelback types. It is a relief therefore to read (p. 27) that these grooves, though useful in expressing stages in evolution, have no taxonomic value. In other words the older systematists, believing grooved teeth to be an ancient character of primary importance, were prepared to split the whole army of non-poisonous colubrines into two broad divisions on this one point. Having done so they were forced to regard any similarities which occurred on both sides of their dividing line, for example the "flying" and egg-puncturing mechanisms referred to, as the results of parallel evolution operating on both divisions. The view adopted in the present book is exactly the opposite; the grooved teeth now become the parallel evolution or, as the author much better expresses it, a "trend in evolution which affects the whole suborder". For a somewhat similar reason—loosening of the headbones to allow of greater swallowing-capacity is the "trend" in this case—the genus *Amblycephalus* (now *Pareas*) is no longer in a family by itself and becomes a subfamily of the Colubridae. I think some of us always rather resented such commonplace, colubrine-looking snakes sandwiched in between two groups of poisonous snakes in the old book and will be glad.

One thing in this book is not clear to me. *Elachistodon,* the egg-eater referred to above, is shown in a family by itself (*Dasypeltidae*) on pages XI, 40, and 403, and as a subfamily (*Dasypeltinae*) of the Colubridae on page 114. If this is a misprint it is the only one I have noticed.

I doubt if a beginner, trying to run down a snake in the field, would find the keys in this book any easier to use than those in its predecessor. Keys in both zoological and botanical works seem to come in for a lot of criticism, mostly based on the rival claims of two types called, I believe, "scientific" and "empirical" respectively. In the strictly scientific type adopted here (and in most F.B.I. volumes I think) the searcher is made to follow, step by step, the processes which led the writer to adopt the arrangement he did. This is undoubtedly the most logical method of all but it is hardly the most helpful. In the present work, for instance, the first thing that the searcher has to ask himself (p. 39) is whether the palato-maxillary arch is incomplete and this is followed by five further questions, all very technical and some of them involving further dissection. These six questions are actually a summary of the reasons for separating the blindsnakes from the rest of the order—a matter more fully discussed, and with admirable clarity and illustration, on page 41. It is quite a concise summary—but is it a key? Surely, at this stage, some hint about the eyes or about scaly bellies and ventral shields would have been more helpful to a non-specialist observer and surely it is mainly for non-specialists that a key to the families is intended—anyone capable of answering the palato-maxillary conundrum might be expected to know that it was a blindsnake he was dealing with.

Personally I can see no objection to a purely empirical key—the sort that does not hesitate to lump together totally unrelated groups provided they possess some outstanding character in common—and, if this is permitted, it opens up possibilities for simpler keys. At some stage in the identification of any snake a scale-count is inevitable—usually at least two, midbody and ventrals—and this suggests the possibility of numerical sorting. Wall's "How to Identify the Snakes of India" (1923) is unfortunately a little out of date now but, even so, I think many of us still find this excellent statistical key the simplest means of running down an Indian snake.

Seeing that Dr. Malcolm Smith's keys are certainly no more difficult to use than those in many similar zoological and botanical works it is, perhaps, unfair to air the whole subject of keys in the review of a book which, above all, aims at making things clear to the uninitiated throughout and especially in the thirty-five pages of his Introduction. Nevertheless I feel that the importance of designing zoological or botanical keys with an eye to the unspecialized user should be stressed—it is through unspecialized observers in out-of-the-way stations that much useful information comes to light.

The inclusion of English "trivial" names is welcome. The author has wisely not attempted to issue one to every species but most of those in common use will be found here, among them those that became current throughout India when Wall was writing in the Bombay Natural History Society's Journal. Trivial names—especially group-names—sometimes serve as an anchorage in the shifting sands of scientific nomenclature. This is the first time that I have met the useful group-name "racer" outside American literature. The author here applies it to the whole genus *Coluber* and to some *Elaphe*—reserving "rat-snake" for *Ptyas*. Ditmars uses "racer" for all *Coluber* too, but calls our two Indian *Ptyas* "racers" as well. On the other hand I think he would call some, at least, of our *Elaphe* "rat-snakes", because they constrict and are relatively slow-movers.

Apart from what I have said about keys—and they, after all, are no more formidable than Boulenger's—the ordinary person will find this book easy to work with because all technicalities are really well explained in the Introduction. He might reasonably ask for a glossary of technical terms to direct him to these explanations but—and this will serve him far better—he can *start* by reading the first thirty-five pages which will tell him all he needs to know. I ought to have done this myself.

In all 389 species and 17 sub-species are described, against 264 in Boulenger's book which, however, did not include the whole of the Indo-Chinese sub-region. An account of the regions dealt with and the geographical divisions was published in Volume I of this series (on the tortoises) and has not been repeated here—a pity, I think, because otherwise this volume is completely self-contained and records all at present known about Indian snakes in a single handily-sized book.

E. O. Shebbeare.

AN APPEAL

The Librarian of the India Office in London has advised me to write to you to enquire if you can help me. I am reading a paper on "Hinged Teeth in Mammals" to the London Zoological Society on March 12th. Later I wish to complete the work by studying the male tushs of musk deer (*Moschus moschiferus*), Chinese tufted deer (*Elaphodus cephalophus*) and Chevrotaine (*Tragulidae*).

It is impossible to procure skulls, mounted heads or preserved heads of any of these in this country, even the Natural History Section of the British Museum being without specimens owing to bombing. I know that I ask the impossible almost but I should be grateful if you could wave your magic wand and procure me any macerated, mounted or fresh heads (in formalin or spirit) of the males of these two deer or any male specimens of Chevrotaine.

County Borough of West Ham,
Orthodontic Clinic,
84 West Ham Lane,
Stratford, E.15.
11*th February*, 1946.

JAMES AITCHISON,
H.D.D., L.D.S. (Glas.),
Supdt. of Casualty Services.

MISCELLANEOUS NOTES

1.—MUSK-SHREW (*SUNCUS CAERULEUS*) ATTACKING A BULL-FROG.

Referring to K. S. Dharmakumarsinhji's observations in respect of a Musk-shrew attacking a Bull-frog (*Journal, Vol.* 46, p. 180), I am inclined to believe that the Musk-rat, not being a rat, occasionally takes it into its head to add some juicy diet to its insect menu and the easiest prey is the frog. I have witnessed it attacking a Bull-frog of full size, the latter, true to the creed of passive resistance, making no attempt to escape.

80A, Kurla Road, Andheri. V. M. VASU,
28th August, 1946. *Advocate.*

2.—NESTING HABITS OF THE FLYING-SQUIRREL (*PETAURISTA PHILIPPENSIS*.)

Whilst felling an Ironwood tree on our estate in the Anamallai Hills last September, I noticed an adult flying-squirrel (*Petaurista philippensis*) glide away from a hole in the tree.

After the tree had fallen I examined it carefully and found the nest hole, which was about 60 feet up. The nest, which was about 5 feet long and a foot in diameter, filled a natural hollow in the tree and it had an entrance at each end. It was well lined with grass, moss, and a quantity of fur.

The nest was empty but a careful search revealed a baby flying-squirrel on the ground.

Its eyes had not yet opened though it was more than a foot long. As it was alive I took it home with me and fed it on well-watered milk by means of a piece of bicycle valve-rubber inserted into the end of an ordinary teat. It took to this readily and had about ½ ounce every 3 hours.

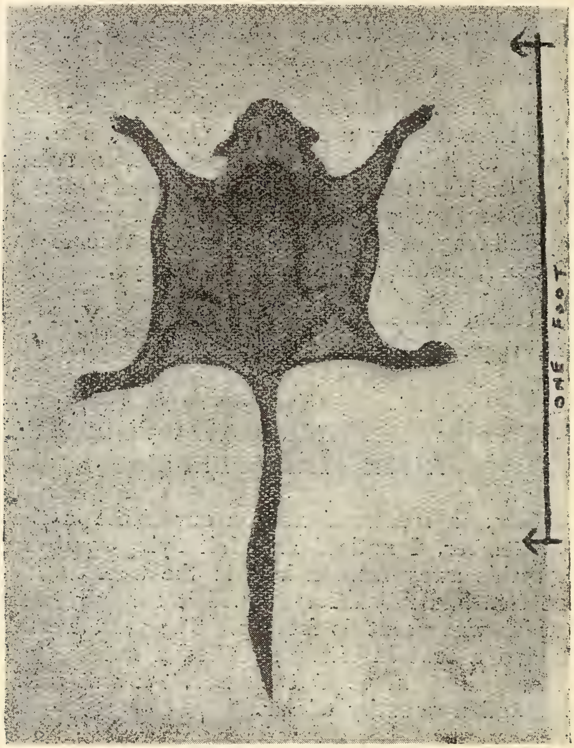
Unfortunately it caught a chill and died after I had had it a week; and even then its eyes had not opened.

I enclose a photograph of it which I thought might be of interest to you. The foot rule which is alongside gives you a fair idea of its size.

As can be seen from the photo its head is out of all proportion to the rest of its body and also the last 5 inches of its tail is curiously flattened, a peculiarity that I have noticed in one or two adult specimens. Another interesting thing was that the bony "yard-arms" which extend the skin, "wing flaps", from the front paws, had not yet developed; instead the "wing flaps" ended at the elbows.

When handled it would make a series of high whistling noises, ending with a squeak.

In colour it was not unlike an adult, except that its tail and feet were jet-black, and it also had a black band across its shoulders. The underparts were white and light-grey.



A young flying-squirrel.

I do not know whether the flying-squirrel undergoes any colour changes before it reaches the adult stage, but recently I was shewn a half-grown specimen which was a light fawn in colour all over, with no other markings at all.

High Wavy Estate,
Cumbum P. O.,
Madura District, A. F. HUTTON.
S. India.
17th September, 1946.

[Little or nothing is known regarding the breeding habits of flying-squirrels generally, and Mr. Hutton's description of the nesting of *P. phillippensis* is a welcome addition to the meagre information available about the habits of this species. Being nocturnal in habit, it is more or less common knowledge that flying-squirrels spend the day in holes and other suitable retreats where they are safe from the attacks of most enemies. Eds.]

3.—"RECORD ELEPHANT".

With reference to "Mannlicher's" letter in your issue of April 26th under the above caption: the diameter of the elephant's forefoot (20¼″) gives the circumference of the foot as 63.6″. Twice the circumference of an elephant's forefoot will give the elephant's height—almost to an inch. In the case quoted the height will therefore be 10′7″; so "Mannlicher" measured his elephant very accurately: not an easy matter, for it is very difficult to get an accurate measurement of the height of a fallen elephant, or even a bison. I have shot 2 elephants over 10′ height—both, curiously enough, single tuskers.

Sanderson was quite wrong in laying down that a 10 ft. elephant did not exist; others, who should know better, have expressed the same opinions over 10 ft. tiger! I think Sir Victor Brooke's "Celebrated Tusker" might quite possibly have been 11 ft. high (again a single tusker).

Mucknas (tuskless males) in S. India are generally of colossal size—in bulk, not necessarily in height.

HONNAMETTI ESTATE,
ATTIKAN P.O., R. C. MORRIS, M.L.A.
via MYSORE,
20th May, 1946.

4.—DEATH OF SIX ELEPHANTS.

In March 1945 six elephants (4 cows and 2 calves) fell over a precipice on the Biligirirangan Hills, and died a lingering death. The circumstances surrounding the event are something of a mystery; but that the local aborigines, the Sholagas, were not unconnected with the tragedy is more than a rumour.

The small herd was in the neighbourhood for several weeks, and had made serious inroads into the Sholaga's plantain topes: this much is acknowledged. The rest of the story has been related to me by a Sholaga; and though I cannot vouch for the truth of his statement, yet I feel it is probably not entirely divorced from the actual occurrence. The story goes that late one evening the aggrieved Sholagas spotted the elephants grazing on the hill-side just above the precipice; and saw their chance to be delivered of the herd once and for all. Escape to the north was not possible, the precipice being the highest on that side. Up the hill eastwards, and along the slope southwards were the only escape routes open. Quickly forming 2 parties: one lot climbed to the steep ridge above the precipice; while the second party worked round to the south west of the precipice. On the top of the ridge were rocks in abundance. The lower party started a jungle fire which, fanned by a stiff breeze, swept up the hill-side, effectively cutting off escape to the south, and menaced the elephants, which then commenced to climb the hill. It was then that the Sholagas on the ridge came into action. Elephants are petrified by rolling rocks. I have watched a large herd get into an absolute panic when a single rock rolled down a hillside on which they were grazing. A number of large boulders were rolled down on the unfortunate climbing elephants and in a few seconds they were beating a panic-stricken retreat down the hillside; trumpetting shrilly. On the edge of the precipice they bunched; but only for a few moments; the rocks continued to hurtle down; and one or more may have actually knocked the calves over. A game path runs down the southern end of the precipice; all right for deer, and possibly bison, but quite unfeasible for elephants in normal circumstances. It is thought that, in their terror, the wretched animals tried to negotiate this possible slender avenue of escape and tumbled over the precipice one by one. There they lay with broken legs and internal injuries until death ended their agonies.

I was not able to visit the spot until November 1945—when only the skulls, skeletons, and large pieces of skin remained; also curiously enough, the soles of the feet of the 2 calves.

HONNAMETTI ESTATE,
ATTIKAN P. O.,
via MYSORE,
S. INDIA,
6th January, 1946.

R. C. MORRIS, M.L.A.

5.—"AN ALBINO BOAR"

The following account of a white boar killed on 27th May, 1946, may be of interest. It will be very kind of Society to let me know whether it is a freak of nature or anything else or was it albino.

A party of 3 spears were pigsticking about 45 miles from Udaipur, far away from any villages. A sounder broke out with an absolutely white boar in charge of the harem. It was hunted and eventually killed. The following points will be of interest:—

(a) It fought like hell. As a matter of fact it came in before being speared and died fighting.
(b) It had two scars of about 6 inches long. These showed that it fought with other wild boar to take possession of the harem.
(c) Height 32 inches.
(d) Very good tushes. Total of each lower tushes 8½ inches.
(e) Hairs completely white. I am enclosing few for your inspection.
(f) Nose, eyes and hoofs were pink in colour.
(g) I enquired from the villagers and also sent our Tent Club shikaries to find out whether there were domestic pig in villages nearby. Report showed that there were none within 15 miles.

(h) Please let me know if any other gentleman has killed or seen a wild boar of this type. Major Maxwell of Mewar Bhil Corps was hunting with us; he has stuck pig all over India. He said that it was the first time he had seen a pig of this type.

BATHERA HOUSE, R. D. SINHA,
UDAIPUR — RAJPUTANA. *Major.*
30*th May,* 1946.

[Albinism is not uncommon among certain groups of mammals and birds but is apparently rare in others. Among the rodents, especially rats albinism is quite frequent; among deer and antelopes it is not uncommon; but, among the larger animals it is less frequent. Albino tigers, bison and elephants have been recorded occasionally, but as far as we are aware an albino wild pig is a rarity and has not been recorded. Albinisum is a result of a colour deficiency in the pigment layers of the skin—its reverse, melanism, is an over pigmentation of the dermal layers.—EDS.]

6.—BIRD NOTES OF THE ARABIAN AND RED SEAS.

(An Analysis of Five Voyages.)

(I)	Bombay—Suez	16-6-42—27-6-42
(II)	Suez—Bombay	28-6-44—10-7-44.
(III)	Bombay—Suez	7-2-45—19-2-45.
(IV)	Suez—Bombay	30-4-45—9-5-45.
(V)	Bombay—Suez	14-6-46—27-6-46.

Shear-water sp. *Puffinus pacificus* or *Pterodroma aterrima.*

Frequent in the Arabian Sea from Aden to 900 m. east of Aden in May '45 and June '44 and '46.

The former species is more likely to occur in this area.

Description:—Size of Manx Shearwater. Wholly brown, wings rather long, with paler bar on coverts of some. Primaries and tail nearly black. Tail long and slightly wedge-shaped, but in others shorter (possibly a different species). Bill dark.

Persian Shearwater. *Puffinus persicus.*

Sparse near and east of Aden in February and May '45, and doubtfully present in the northern part of the Red Sea in June '42.

Wilson's Petel. *Oceanites oceanicus.*

In February '45 sparse from Aden to 600 m. east of there. Also there in June and July, as well as in the Red Sea. In June '44 a few were seen within 500 m. of Suez. In June '46 huge numbers were passed for three hours about 240—270 m. east of Aden, and for one hour near the straits of Bab-el-Mandeb.

White-eyed Gull. *Larus leucopthalmus.*

Sparse in Suez in February '45, 90% being immatures. In April, May and June they were frequent at Suez and near the Straits of Jubal. A single bird at the mouth of the Red Sea in July '44.

Aden Gull. *Larus hemprichii.*

Abundant in and near Aden and the mouth of the Red Sea at all times.

Yellow-legged Herring Gull. *Larus cachinnans.*

At Suez in February '45, but not in April, May and June.

Lesser Black-backed Gull. *Larus fuscus.*

In February frequent at Bombay, near Aden, in the Red Sea and at Suez. In April and May at Suez and Aden, and in July common at Aden, 90% being immature birds.

Brown-headed Gull. *Larus brunnicephalus.*

Frequent in February and May in Bombay but not seen in June '46.

Black-headed Gull. *Larus ridibundus.*

In February very abundant at Suez; none in April, May and June.

Gull-billed Tern. *Gelochelidon nilotica.*

Sparse in Bombay Harbour in May '45.

White-cheeked Tern. *Sterna repressa.*

Frequent in Aden in June '42, and what was probably this species of tern in large flocks from Aden to 600 m. east of three, in May '45. Also sparse in the lower Red Sea in June '46.

Description:—A smallish tern with a dark mantle and red bill.

Crested Tern. *Sterna bergii.*

In Aden, up to 400 m. east of there, and in the lower Red Sea during April, May and June. Not seen in February. Never common except in Aden Harbour.

Brown-winged Tern. *Sterna anaetheta.*

In June '42 sparse east and west of Aden.

It was probably this tern that was present in large flocks 150 m. north and south of the Twelve Apostles in the Red Sea in May '45.

Description:—Small. Head white with crown darker. Upper-parts brown, under-parts pale, with darker leading edges to wings.

Little Tern. *Sterna albifrons.*

Common at Suez in April, May and June, but not seen in February.

Common Noddy. *Anous stolidus.*

More than twenty around the stationary ship at the mouth of the Red Sea in July '44, and sparse near the Twelve Apostles in May '45.

Pomarine Skua. *Coprotheres pomarinus.*

In May '45 good views were obtained of one near Suez and one in the middle of the Red Sea, mobbing first *Larus fuscus*, and on the second occasion *Larus hemprichii.*

Description:—Upper-parts brown, paler bar on the primaries. Under-wings and collar brownish, rest of under-parts pale or white. Neck white. Two protruding tail-feathers very noticeable.

Brown Booby. *Sula leucogastra.*

One at Aden in June '46, but otherwise only in the Red Sea, especially near the Twelve Apostles.

Red-footed Booby. *Sula piscatrix.*

Odd birds seen near Aden and in the Red Sea (including one near Suez in June '42) and occasionally from Aden to 900 m. east of there.

Red-billed Tropic-bird. *Phaëton aethereus.*

Odd birds at sea from 400 to 900 m. east of Aden in February and May, two in the Red Sea near the Twelve Apostles and two near Suez, in May.

Red-necked Phalerope. *Lobipes lobatus.*

Ten phalaropes 450 m. east of Aden in February '45, twelve there again in May, and sparse flocks of ten or less in the Red Sea near the Twelve Apostles in February '45.

They were almost certainly this species and not *Phaleropus fulicarius.*

LOENOWERLE,
FEOCK, TRURO, P. I. R. MACLAREN.
CORNWALL, ENGLAND,
3rd July, 1946.

7.—BABAR THE GREAT ON FLAMINGOES.

Some time ago, there was an appeal[1] in the *Journal* inquiring information about seasonal movements or any other general information about flamingoes. The other day, when reading the Autobiography of Babar the Great, Emperor of India, I came across some of his observations on birds[2] and as they throw some light on certain problems regarding flamingoes, I quote a few passages here:—

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[1] Ali., Sálim 1944. The Common Flamingo (*Phoenicopterus ruber*): An appeal. *J.,B.N.H.S.,* Vol. 44, pp. 476-477.

[2] Leyden., J. and W. Erskin, 1826. *Memoirs of Zehirudin Mohammad Baber,* London. pp. 165-166.

"...we reached Ab-Istadeh, when a wonderful large sheet of water presented itself to our view.... When I came within one kos of Ab-Istadeh, a singular phenomenon presented itself. From time to time, between this water and the heavens, something of a red appearance was seen, like the ruddy crepuscule, which again by and by vanished and so continued shifting till we had come near it. When we came close up, we discerned that this appearance was occasioned by immense flocks of Baghlan Kaz (wild geese) not ten thousand or twenty thousand, but absolutely beyond computation, and innumerable, and in their flight, as they moved their wings, their red feathers, sometimes appeared and sometimes were hid. But they were not wild geese alone, innumerable flocks of every species of bird, settled on the banks of this water, and the eggs of countless multitudes of fowl were deposited on every corner of its banks. A few Afghans, who come here and were employed in gathering these eggs, on seeing us fled and threw themselves into the lake...it was of one uniform depth, reaching up to the horses belly."

Ab-istadeh means stagnant water, and it is the only lake in Afghanistan, still known by the same name. It lies at a height of about 7000 ft. from sea level (32°30'N.and 68°E) and about seventy miles south of Ghazni near the head of Tarnak river. It is an open country[1] from meridian of Mookoor to the hills on the right bank of the Gomal river and from Ghawasta to Ghazni, which is the basin of Ab-Istadeh. Waters of the river Ghazni from the north, of the Nahar from the north-east and of other brooks, which remain after watering the cultivated lands and also the superfluous waters of the spring rains in the valleys of Zurmet and Kutta-waz, all flow down into it. It[2] is about forty-four miles in circuit, having salt and bitter water of about uniform depth (not more than 12 feet deep in the middle) and fish entering the salt water from the Ghazni river sicken and die. Its borders are covered with low tamarisks. A plane tree, a poplar or a willow may be seen hither and thither near a *Karaiz* (under ground aqueduct for irrigation purposes), but no natural wood is present and the country is naked and uniform.

Keeping in view that flamingoes affect salt-water[3] and keep to sea-coast only when there is no inland salt-water lake and that the breeding colonies are situated on some lake or lagoon of little depth, with bare shores, it becomes evident that all environmental conditions are favourable for the birds to spend their breeding season in Ab-Istadeh. Again when we look at the pictures[4] of a flamingo city, which recently appeared in the *Journal* (populated by a vast number, not less than half a million birds), the emperor's wonder at the immense number appears quite natural. All these features lead us to conclude, as also the translators of the autobiography think, that the birds in question were flamingoes.

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[1] Elphinstone, M. 1939. *An Account of the Kingdom of Caubul.* London. Vol. 2, p. 140.

[2] Y. . H , 1875. Afghanistan. *The Encyclopaedia Britannica,* 9th Edition, London, Vol. I, p. 230.

[3] Evans, A. H. 1922. *The Cambridge Natural History.* Vol. 9, p. 107.

[4] Ali S. 1945. More about the Flamingo (*Phoenicopterus ruber roseus* (Pallas) in Kutch. *J.,B.N.H.S.,* Vol. 45, pp. 586-93.

The word *Baghlan Kaz* used by the emperor to denote the bird also requires a little consideration. Baghlan does not mean *wild* as it has been erroneously translated, but it is a city to the north of Kabul. It is obvious that Baber, by using this word, means to refer to the same distinct kind of kaz or goose which he had previously seen at Baghlan.

Cumming[1] has recorded only two species of flamingoes to occur in Afghanistan, viz., *Phoenicopterus ruber roseus* Pallas, and *Phoenicopterus minor* Geoffroy, from Kohak, which is situated to the south-west of Ab-Istadeh, but Whistler does not take into account the former though he is confident that both species do occur in the country. The Emperor notices red birds and emphasises on this very character of redness by repeating it and using different words as *red appearance, ruddy crepuscule* or *red feathers*. Under these circumstances one is inclined to believe that the birds referred to above belonged to the species *P. ruber roseus*.

Some twenty-two years ago, a large flock of flamingoes was seen by Law[2] flying past over the sea to their winter quarters as early as the month of August. He remarks, "When one finds that a bird which migrates out of India in May at the earliest, returning as early as the 19th August, one is naturally led to suppose that the bird has been so journeying these few months somewhere in close neighbourhood of India". The earliest movements of the birds for their summer quarters do not appear to begin from May, but somewhat still earlier, as Cumming has noted a flock flying overhead at Kohak (outside India) on 28th April travelling northwards. The above incident at Ab-Istadeh, as it appears from the date given for the incident preceding it, cannot have occured otherwise than at the end of March or in the month of April.

It may be surmised from the above account that the flocks of flamingoes fly during their migratory movements north-wards in early summer or spring over Kohak, Ab-Istadeh and Baghlan in Afghanistan and that one of the breeding places of these birds possibly the one nearest to India, is Ab-Istadeh, where the birds, most probably, belonging to the species *P. ruber roseus* Pallas gather in large numbers from the month of April onwards.

FACULTY OF SCIENCE,
KABUL, S. A. AKHTAR.
5th July, 1946.

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[1] Whistler, Hugh. 1945. Materials for the Ornithology of Afghanistan. *J.,B.N.H.S.*, Vol. 45, p. 480.

[2] Law, S. C. 1924. A note on the early arrival of Flamingoes in India. *J.,B.N.H.S.* Vol. 30, pp. 226-27.

8.—OCCURRENCE OF BAR-HEADED GOOSE, [*ANSER INDICUS* (LATHAM)] NEAR HYDERABAD CITY (DECCAN)

On the 30th November 1945 I went with a party on a duck shoot. Two small tanks exist about 18 miles south-west of Hyderabad City about 1½ miles cross country south of Himayatsagar reservoir.

First the large tank was visited with no result and we decided to go back home as there was no chance of getting any game in the other tank. To our joy, one of us spotted a big bird swimming in the middle of the tank. My younger brother shot it with a .22 bore rifle and broke its wing but the shot was not fatal, however, we could at last bag it and when it was taken out, it was found to be the Bar-headed Goose. The villagers told us that they had never seen such a 'duck' before. We made enquiries from other brother shikaries also and their reply was in the negative.

So far as I could find out from the papers, this bird has been reported from Mysore, Travancore, Madras and Bombay, although it is not so common as in Northern India. I think this was one of the stragglers to reach Hyderabad State, because large gaggles have never been observed here.

Mr. Sálim Ali, who has conducted an Ornithological Survey of Hyderabad State may be able to explain its migration better, and I shall feel much obliged if anybody else may be kind enough to enlighten me in this matter.

M. RAHIMULLAH, D.SC.

[In "Reminiscences of Sport in India" Major-General E. F. Burton (published about 1870) observes that on a march between Hanamkonda and Parkal Lake "the wild country was studded with fine sheets of water which were full of ducks and geese of all kinds". The geese referred to were presumably Bar-heads, but there seem to be no more specific records from Hyderabad State.

The species has been observed on the Godavari River near Nasik, and shot in the Kistna District adjoining Hyderabad territory on the east. It was evidently "extremely common" on the Chilka Lake (Orissa) in the eighties of the last century (Hume, *Game Birds*, iii, 82) and small numbers are still said to visit the place in winter. The birds visit favourite tanks and paddies in Mysore fairly regularly, and a few have been known to straggle further south to the extreme limit of the peninsula.

It would be interesting to learn what factors are at work in decreasing the numbers of these annual visitors to peninsular India, as undoubtedly appears to be the case. EDS.]

9.—THE RED-CRESTED POCHARD (*NETTA RUFINA*) IN SOUTHERN INDIA

On 9/2/46 when shooting at Tyravallur lake, about 30 miles from Madras, we got four Red-crested Pochard (*Netta rufina*), two drakes and two ducks.

When I returned to camp I looked this species up in *Fauna of British India* (Stuart Baker) and found that he says that there are hardly any records from Southern India, so I thought I would write to you.

On several occasions lately I have seen the Common Pochard (*Nyroca ferina*) on various lakes round here, but have not yet taken any. I believe them to be rare in Southern India also.

I have preserved two skins of the Red-crested Pochard and have done soft part studies of them, which I can send if confirmation is required.

I would be obliged if you could let me know what the status of these duck is in Southern India. On Tyravallur there were about 200 Red-crested Pochard which regularly flighted from one end of the lake to the other over some islands, providing ample opportunity for observation.

R.A.F., H. G. LUMSDEN F/O.,
S.E.A.A.F., 82 *Squadron.*
11*th February,* 1946.

[From all accounts the Red-crested Pochard is rare in South India. A flock of the size observed by our contributor is certainly quite exceptional.

The Common Pochard is an irregular winter visitor to S. India, but by no means as rare as has been supposed.—EDS.]

10.—MAGPIE ROBIN'S NEST IN A HOUSE.

Although the magpie robin (*Copsychus saularis*) is a common bird of gardens, I was not aware that it ever made its nest in an occupied house almost like a sparrow. The house has a flat roof partly shaded by the spreading branches of rain trees. In the middle a square brick chimney stands about 3½ ft. high. The top is covered by a large flat slab of stone—the smoke finding its way out through grills in the four sides, and the robin finding its way in by the same entrance.

In the centre is a partition dividing the chimney in half; a couple of bricks are missing from one side of this, and in the niche is the nest, almost overhanging the chimney.

On 4th June I first noticed the nest; there were 3 young birds. By the 9th they were half fledged. On the 15th one of the young fell, or was pushed over the edge and fell down the chimney. I restored it to the nest. There did not appear to be room for 3 half grown birds anyhow it soon re-appeared in the fire place on the ground floor. The cat ate it.

On the 20th a second almost fully fledged youngster came down the chimney. It could flutter along the ground, almost air borne.

I restored it to the nest which was empty, a second youngster having disappeared meanwhile. The third was too restless to stay put, and soon came down the chimney again like Santa Claus, although there was now plenty of room in the nest. I restored it a second time, not to the nest but to the flat roof under the branch of an overhanging tree in which an agitated and chirping mother was waiting on events. She did not however go to her offspring which lay low. After several minutes the young bird with a short runway at its disposal took off, cleared the low parapet and planed down to the lawn where I lost sight of it. I think the mother did too; the cat was probably the more vigilant of the two.

I thought possibly one of the 3 youngsters might have been a cuckoo; but no bird much larger than a robin could possibly have squeezed through the grating into the chimney. The nest filled the entire niche, and if a young bird fell or was pushed out it *had to* go down the chimney.

The nest was of long flexible fibres very like fine needles to look at, but may have been midribs of compound leaves. A long strand of very fine copper wire was incorporated, no lining of feathers or soft grass of any kind.

CINNAMARA P. O.,
ASSAM, F. KINGDON-WARD.
9th July, 1946.

11.—BIRD NOTES ON THE DHAL LAKE, KASHMIR.

While sitting on a houseboat at Nasimbagh we spent much time watching the peculiar habits of the Kashmir sparrow.

These birds would spend half their time hovering over the water like kingfishers. Every now and then diving at the water. On one occasion we saw a sparrow actually catch a minute sprat and, fly with it on to the roof of the houseboat. I was unable to climb the stairs fast enough to see whether he threw it in the air and swallowed it head first like a kingfisher or returned to his sparrow habits and pecked at it.

There were a pair of osprey on the lake but I never located their nest. While watching one of these birds fishing he suddenly dived, went completely under water, and for some time looked as if he might never get out. However, after three attempts he got into the air carrying a large fish say 2 feet. While I was still watching the fish gave a jerk and bird and fish fell almost into the lake before the osprey improved his grip and got the fish safely to a tree.

On another day I saw two large divers and followed them in a shikara. Whenever I got near they dived and came up 100 yards away. However I was able to see that they had large cormorant-like beaks, yellow facial skin reaching to the eyes some white on the lower breast, and were generally a brownish colour.

If I had been in Upper Burma where hundreds of shag appear in the cold weather I would have said *Shag*. However I am told that there are no such things in Kashmir. I wondered if this note would result in my hearing of any one else having seen a shag in Kashmir or further north. The time was early June and I never saw them again.

NEDOU'S HOTEL,

SRINAGAR, C. E. MILNER.

26th July, 1946.

12.—ANCHYLOSED FANGS AND SOLID TEETH IN SNAKES.

Comparison of the length of fangs in some American snakes with that of the snake which possesses them suggested that the same principle would apply to their solid teeth which had become anchylosed to the jaw.

In measuring these small teeth one must guard against the measurement of ill developed teeth which are not yet anchylosed or the confusion of loose teeth from the erect row with some of the soft teeth of a hinder row.

Bitis arietans Merr. would seem to possess anchylosed teeth corresponding with the length of the snake at all ages, the front tooth of specimens eighty to ninety mm. in length being one millimetre longer than the rest.

The same would seem to be true of *Déndroaspis augusticeps* Smith whose big front tooth is only two millimetre long in specimens from 220 to 225 mm., and in *Naja* with 6 mm. fangs, the long narrower teeth of *Bitis* being related to slow movements.

Loss of teeth is infrequent except during dissection and it is uncommon to come across a broken tooth among the rows of teeth which are commonly alternately anchylosed, so that an anchylosed tooth seems to grow with the jaw.

Persistent pulp is readily seen in these solid teeth even after anchylosis, as it occurs in an anchylosed fang, and is evident before a tooth has developed along with the socket to which it becomes attached.

Once a fang or solid tooth has become anchylosed it could hardly be extracted without leaving some trace and loss of a whole tooth or fang strongly suggests that it had never become properly attached to the jaw.

Hinder teeth loose in the gum seem to represent those which are functional in fishes, there are two or three rows in the front of the jaw only in some snakes and lizards and these would not appear to be capable of moving forward to replace teeth lost from the erect row.

BRITANIA BUILDINGS,
WEST STREET, DURBAN, F. GORDON CAWSTON.
SOUTH AFRICA.

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13.—CONSIDERATION OF THE SUCCESSIONAL THEORY OF TEETH.

Where replacement of teeth is provided for in Nature it is almost always by vertical succession and the apparent exception of the elephant dentition would seem to be explained by the fact that the jaw is too small to accommodate all the teeth.

In fishes loss of teeth is sometimes provided for throughout life by new teeth erupting between the bases of functional teeth but there is no revolving of the tooth-bearing area so as to cause replacement from a hinder row of teeth.

Selachian teeth are set in several rows, the number of which is constant for the species, though each row may not be complete. This corresponds with the rows of teeth of many fishes including what are popularly known as the Mussel Crushers.

It is sometimes thought that the hinder rows of teeth in the Mussel Crusher are for replacement of teeth lost from the front row but this idea is proved to be false by X-ray examination or dissection which reveals the unerupted teeth.

Evidence that the hinder rows of teeth in selachians are for replacement is lacking, though an individual tooth in the living loose gum would inevitably help to close the space caused by lost of a tooth from the front row.

In some species there are very small sharp teeth in front of the large foremost row of vertical teeth and these slender teeth show no indication of wear and tear whilst overcrowding of the anterior ones renders loss and replacement impossible.

One is forced to the conclusion that there is no provision for replacement of selachian teeth, that the hindermost ones never come into use and that the term 'succession of teeth' cannot properly be applied to this dentition.

Reptilian teeth also show no evidence of revolving of the tooth-bearing area, with the possible exception of the fangs of snakes whose serial form is perplexing in view of the unlikelihood of replacement of the back fangs

Three rows of teeth in the front of the jaw of prehistoric reptiles should not be associated with replacement and X-ray examination or breaking of the fossilised jaw would probably reveal evidence of vertical succession.

In the African and Indian crocodiles there are three rows of teeth which may be described as erupted, reserve and residual, the last remaining undeveloped in the oldest crocodiles and the size of the teeth corresponding with age.

The difficulty of appreciating that reptilian and piscine teeth can grow after eruption is due to the fact that their persistent pulp or pulp canals enables them to increase in size and in depth of the buried apex.

There is no support for the theory that the small loose teeth in the gum of a Python ever serve for replacement and, unfortunately, snakes in captivity do not survive very long especially if their teeth are interfered with.

These extra teeth are of use in holding fast-moving prey and a snake which has no poison glands needs an extra strong hold besides its rows of back-wardly directed teeth of which the python has a large number.

There is no sign of tooth development in the jaw below the solid teeth of snakes and it is unlikely that loss of a solid tooth is ever provided for in a snake's short life, nor is it likely that reserve fangs ever become functional.

An extra anchylosed fang in some snakes *suggests* that it is about to replace the one which is in use but there is no record of rudimentary poison glands or of a reserve fang having successfully replaced an artificially removed one.

Persistent pulp in a functional fang indicates continued growth and this would seem to correspond with the growth of crocodilian teeth whose exposed ones sometimes have a complete hole through which the replacing tooth has moved.

In the Batoidei the number of teeth in a species is not constant and it would seem, from examination of both adult and embryonic material, that the number of teeth are added to at the anterior border as often as at its posterior end.

The successional theory would seem to depend on the integrity of William André's report of abnormal teeth in the jaw of a shark whose jaw had been penetrated by the spine of a sting-ray.

Unfortunately it would not appear that anyone has looked for the *foramina* in these 'abnormal' teeth and a more possible explanation is that the 'abnormal' teeth are all teeth which were split through the foramen at the time of the injury.

It may be noted that the split, if such occurred, has taken place at the weakest portion of a tooth, namely where the pulp canal extends from the basal portion to the highest point of the tooth and corresponds in each such tooth.

Until experimental proof is forthcoming, and such is often cruel rather than convincing, vertical succession of teeth would seem to be the only one in these animals and, possibly, also in the case of olluscan teeth.

In studying the embryonic *radula* I was impressed by the fact that the foremost teeth were often devoid of cusps in the embryonic state and corresponded with that of adult molluscs, though the latter often possess many rows of blunted teeth.

If as the individual mollusc grows the cusps of the teeth tend to coalesce then the number of teeth in each row with three cusps would increase in number without the need for supposing that the front part of the *radula* was continually shed.

These older molluscs certainly contain broader and longer *radula* in many of the fresh-water species than do the immature ones and it would seem certain that the rows are added to from both the sides and at the nascent posterior end.

Britania Buildings,
West Street, Durban, F. GORDON CAWSTON.
South Africa.

Reference.

André William 'An attempt to prove that the teeth of Cartilaginous Fishes are perpetually renewed' *Phil. Trans. Roy. Soc.*, 74 1784.

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The *Dent.* Record. lx, No. 11 pp. 435-439.

1941 'A consideration of the Teeth of Embryonic and Immature Skates and Rays in relation to the successional theory of teeth.'

S. African Dental, *Jour.* xv, No. 4, pp. 95-98.

1943 'Some notes on the possible replacement of teeth in *Gavialis gangeticus.*' Current Science Vol. 12, No. 4, p. 114.

14.—HABITS OF THE BAKA FISH [*BARBUS* (*LISSOCHILUS*) *HEXAGONOLEPIS* McCl.]

I am wondering if you can throw any light on the curious behaviour of the fish in the small river hereabout; they appear to collect in one pool, literally thousands of them, and you can traverse for miles up stream and see no fish at all. These fish are mostly Baka, running up to 6 or 8 lbs. We notice it every year at this time and always the same pool. Are they spawning or waiting for a spate, or what fishing is utterly spoilt and they don't seem to move again until it gets warmer in Feb. Min. temps. have been 42-43 recently; unusually low.

Monabarie T. E.,
Mijikajan P. O., R. M. PIZEY.
Assam,
5th January, 1946.

[Regarding Mr. Pizey's enquiry Dr. Hora writes:—

'The Baka fish of Assam is the same as *Katli* fish of the Nepalese. I have written 3 articles[1] about this fish in the series of Game Fishes of India. For its general habits those articles can be consulted. The only explanation that I can think of the behaviour of this fish is that in the hills at this time due to cold the water in the shallower parts of the stream becomes very cold and the fish are likely to be benumbed. Deeper water is more warmer and, therefore, the fish congregate in those water and save themselves from cold. I think that is the explanation for the peculiar behaviour of Baka observed by Mr. Pizey. The breeding season of this fish starts from April in some warmer waters and is continued up to September-October in higher altitude or colder waters. So what Mr. Pizey has observed cannot be the spawning movements of the fish. The cold water is responsible for the fish not taking any food because it is well-known that during cold, the movements of fish are inhibited and therefore much energy is not spent.'—Eds.]

15.—THE GIANT FRESHWATER FISHES OF ASIA.

The September issue of the Journal was not delivered to me here till the 5th instant, hence the delay in writing to you.

With reference to the last para of your footnote at page 376 I spent 14 years in Iraq and made extensive enquiries about fish and fishing in the country and sent you a number of specimens for identification. Some of these you sent to the British Museum, but up to 1938 the Curator told me he had not been able to deal with their identification and classification. He showed me Heckels descriptions and I found that the correct spelling for '*Scheich*' was '*Scheick*', which of course was the German way of spelling our word '*Sheikh*'. Unfortunately not having Heckels book with me in Iraq I was unable to identify the various fish I and others caught or which were netted, poisoned, or otherwise obtained by the Arabs and Kurds. The 215 lbs. fish referred to, I was informed by the Arabs, had been speared by them, and the 123 lbs. was hooked on "Atta". I was unable to get any authentic information about any large fish caught on fly or spinnings, so when I hooked and landed one of 118 lbs. on spoon it was considered I held the record for the largest fish hooked and landed on normal spinning tackle. A year or two after I retired from Iraq in 1933, Major Wilson landed a 120 lbs. but I have never heard any details. I wrote annually about the results of my fishing trips to the Editor of the Fishing Gazette and he published my reports; I also sent him a photograph of the largest fish caught in a net on the Euphrates just below the Hindiyah Barrage in January, 1925, and he published it. This fish was 7 feet long, 4 feet in girth and weighed 252 lbs. 48 hours after capture! The original photo is still with me and I can send it to you if you would care to see it and publish it. The Arabs informed me that the biggest one they had ever captured was about 300 lbs. and I should think that that is about the maximum weight these fish ever attain to.

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[1] *Journ., B.N.H.S.*, xlii, pp. 78, 305, 526.

With the exceptional facilities that I had I was able to try out the fishing in various parts of Iraq and I had intended writing you a comprehensive article in 1938 for the Journal, but the tension in Europe then and since made me give up the idea, however if you would still care to have such an article I might attempt to write it now. Just before I left Iraq the Govt. there were taking an interest in the fish life of the country and by now they may be in a position to give you any information I am unable to do.

RIXDAL COTTAGE,
ABBOTSHAM,
BIDEFORD, N. DEVON,
ENGLAND,
5 *February*, 1946.

O. G. KIERNANDER.
Major.

[Dr. Hora in a letter to us gives the spelling of the Barbus referred to, as *Barbus schejk* Heckel. He says:

'*Barbus schejk* (Heckel) is a large carp inhabiting the rivers in Mesopotamia. It has been all along confused with some other closely allied forms such as *Barbus xanthopterus*, etc. It is not a *Tor* type of fish but a *Puntius* in virtue of its interrupted labial groove.

The photographs appearing in *J.,B.N.H.S.*, xxvi, pp. 679 and 680 are not really of *Barbus schejk* but of *Barbus esocinus* (Heckel).'—EDS.]

16.—LIST OF CROP PESTS OF THE BOMBAY PRESIDENCY.

Messrs. Trehan and Pingle's very interesting paper under the above title (1946, *Journ., Bomb. Nat. Hist. Soc.*, xlvi, 139) contains several statements somewhat at variance with my own breeding experiences in Calcutta. It seems worth while, therefore, recording them.

Amsacta moorei Btlr.—I have not bred this species, but the remark 'hibernates as pupa in the soil' shews a most unusual habit for an Arctiid. Arctiids are cocoon spinners and, although the cocoon may sometimes be placed under a clod of earth, I hardly think that this can be described as 'in the soil', which gives the impression of a subterranean pupa of the Noctuid type.

Spodoptera mauritia Bsd.—It is strange that this should be single-brooded in the Bombay Presidency; in Calcutta it comes to light all through the year. I have bred it in most months, both in the hot and the cold weather, and I have never noticed any tendency towards delayed emergence in the pupae.

Nymphula depunctalis Guen.—This, again, comes to light all through the year in Calcutta.

Sylepta derogata F.—When cotton plants are not available, it will probably be found feeding on other *Malvaceae*. In Calcutta it is a serious pest on Hollyhocks early in the year.

Utetheisa pulchella L.—Is it certain that the species is *pulchella* and not *lotrix* Cr.? Friends in the British Museum inform me that the latter is the common species in India. The easiest point of difference is the black tornal spots of the forewing, which are elongate in *lotrix* and round in *pulchella*. An alternative food-plant is *Heliotropium indicum*. I doubt pupation 'in' the soil.

Prodenia litura F.—A continuously brooded species, with innumerable food-plants.

Eublemma olivacea Wlk.—The larva is here described as green. Mine were a purple-brown with rings of small yellow-green dots.

Herse convolvuli L.—There is also a green larval form. In Calcutta the life cycle occupies about five weeks, I have had moths emerge thirty days after the laying of the ova.

Achaea janata L.—The normal habit of this group is to pupate in a slight cocoon between two leaves.

Pericallia ricini F.—I have found this to be continuously brooded in Calcutta. It certainly spins a cocoon in which to pupate, a favourite site in Calcutta being in the angle, or under the coping, of a wall.

Trabala vishnu Lef.—I would call this a large caterpillar. I have seen single plants of Castor growing in Calcutta completely defoliated by it.

Dichocrocis punctiferalis Guen.—Described as a dark brown caterpillar, my description was dirty whitish grey, slightly tinged with pinkish.

Acherontia styx Westw.—There is also a brown and a yellow larval form.

Papilio demoleus L.—It is surprising that *Papilio polytes* L. is not also recorded.

Ophideres fullonica L., *O. materna* L.—The larvae feed on *Tinospora cordifolia* Miers, and on other species of *Menispermaceae*.

CALCUTTA,
19*th July*, 1946. D. G. SEVASTOPULO, F.R.E.S.

17.—DRAGON-FLY PREYING ON A SCORPION.

On noticing a fairly large red bodied Dragon-fly of the type common here, flying with something striking out at right angles to its line of flight in front of it, I watched it land and proceeded to investigate. It settled on a doorstep and it had hold of a baby scorpion which was valiantly trying to use its dimunitive tail against the dragon-fly's head. The fly seemed to have hold of the scorpion somewhere in the region of the thorax. I did not observe further as on being disturbed the dragon-fly went off with its burden.

PENGKALAN BUKIT ESTATE,
MUAR, JOHORE, MALAYA, J. A. HISLOP,
30*th May*, 1946. *Major*.

18.—SEA ANEMONES AS ENEMIES OF BIVALVES

It is well known that the large sized sea anemones generally feed on small fishes, shrimps and crabs which they paralyse with their tentacles. Broken pieces of animal and vegetable matter contained in the sea water are also wafted into the stomach and digested. The molluscan eggs and larvae and shell fish with thin and fragile shells may also form a part of the food of larger coelenterates. It is however not known whether the sea flowers are capable of feeding on hard shelled bivalves.

The other day while collecting shells from the Mahim sea shore, I noticed a fully developed bivalve (*Donax scortum*) idly ploughing its way across a mud-flat. It had not proceeded a few yards before it appeared to bury itself in the mud. In a short time however I could see the two valves thrown out to the surface without the inmate within. The disappearance of the animal was a surprise to me. Searching in the spot where the living *Donax* appeared to bury itself I found a large sea-anemone which with its mouth closed and tentacles drawn in resembled a ball of jelly. Probably this jelly fish must have swallowed the mussel. I poked the animal with a rod to see if I could trace the shell fish inside its stomach. I was not successful in my attempt as the jelly got mixed up in the black slimy mud.

Any way concluding that the sea anemone had been responsible for the disappearance of the *Donax* the question remains as to how the former managed to extract the latter from its shell.

While moving all bivalves keep the shell valves slightly open exposing the foot. In this particular instance the naked foot of the *Donax* having come into contact with the venomous tentacles of the sea anemone must have got paralysed and the jelly fish would have pulled the mollusc out of its shell. This explanation however is based on the assumption that the pulling power of the sea anemone is more than that of the adductors of the mussel. I leave the explanation to be confirmed at the hands of more experienced naturalists.

C/o The Cement Marketing Co. of India,
Esplanade House, Waudby Road,
Fort, Bombay, T. V. SUBRAHMANYAM, B.A.
2nd July, 1946.

19.—MALAYAN NATIONAL PARK.

The King George V Memorial Park, to give its full title, is about 1,700 square miles of uninhabited and partly unexplored country surrounding the highest peak in Malaya—Gunong Tahan, 7,186 feet. It lies partly in each of the three States of Pahang, Kelantan and Trengganu and is mostly hilly tree-forest with some small patches of flatter grass-jungle and a little savannah and high-level scrub. I believe it is true to say that Government instituted the Park chiefly on the advice of the late Theodore

Hubback—certainly it would never have become a concrete fact but for his enterprise and energy. Unfortunately he was murdered in the jungle during Japanese occupation.

Before the Japanese invasion Government was spending about seventy thousand Straits dollars a year on maintaining and developing the tract as a national park. This was spent mainly on the pay of a European superintendent, game-rangers, boatmen, etc., on keeping them provisioned, mostly by out-board motor-boats and on making and maintaining paths and buildings. There were two timber rest-houses, one at each end of the park, and twelve ranger's posts each with two huts of grass and bamboo built over a concrete floor. Each post was occupied by a Ranger and two other men who patrolled beats and kept the paths clear.

The objects of the park were, firstly, to preserve the fauna and flora of a typical tract of inland Malaya in perpetuity and, secondly, to make this accessible to the public as early as possible as a holiday resort and for scientific and educational study. Transport difficulties limited the second object to about a dozen small parties before the war and the park was never fully opened to the public. These few experimental trips proved, however, that even with the very limited resources then available it was almost always possible to show visitors *sladang*[1] at close quarters and that other birds, beasts, scenery and fishing provided ample attractions for those who appreciate an out-door holiday. The many unofficial applications received for similar excursions revealed a growing interest in nature and camping holidays among both Europeans and the educated members of the Chinese, Malay and Indian communities.

Though it is too early to expect Government to decide on a post-war policy for the park, there is no harm in my setting down my own views on its future possibilities. To begin with then though it is hardly likely that the whole project will be scrapped and the park abolished Government may not feel justified in continuing to spend large sums indefinitely on an unproductive venture, especially during slumps. It is therefore most important to make the park self-supporting as early as possible—if this is possible at all. There are many who think that it is not—but the same has been said at the beginning of most, if not all, such schemes—of the Kruger National Park certainly, and I believe also of the famous parks of North America, though Americans and Canadians seem to take more interest than we do in such matters.

The general opposition argument is:—'Who is going to pay to go into a forest where he is not allowed to shoot?' and the special lines for Malaya:—'You can't show game in heavy jungle' and 'Nobody in Malaya wants to leave the tarmac'. Of these three the first has been out-of-date since the observation of wild life and animal photography became popular, the answer to the second is to use an elephant instead of field-glasses and the third

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[1] Sladang is the Malay name of *Bos gaurus* which we ordinarily call bison in India or, perhaps more correctly, by one of his vernacular aliases such as Gaur (Hindustani), Gauri-gai (Gurkha) or Mithun (Assamese). It is, I believe, the largest of living bovines and quite the most impressive sight in the Park.

I now know to be a calumny on a large and growing section of the Malayan public.

Originally we intended to exclude motor-cars from the park entirely but later decided that about fifteen miles of unmetalled or laterite motor tracks in the west of the area would be necessary if our aim is to show the greatest amount of wild life to the greatest number of visitors. The conversion of the railway from Kuala Lipis to Merapoh into a road by the Japanese makes this project more attractive since it would make possible short trips to an interesting part of the park for visitors in their own cars—an important gain from a box-office point of view. One of these motor-tracks would connect Merapoh with Sungei Ngeram a fishing camp which may be considered the headquarters of the western end of the park, though the rest-house there was unfortunately burnt down during Japanese occupation. From here motor-tracks could be made to a well-known salt-lick to the north and to a *sladang*[1] grazing-ground and fishing river to the east There would be room to extend this system of motor-tracks later if desired as much of this part of the park is comparatively easy country.

For more extended tours, lasting ten days or so, travel would be by footpaths between temporary camping-grounds on fishing rivers, combined with boat-journeys on navigable reaches. Hitherto transport has been the limiting factor for journeys of this kind. Porters are scarce and the best of them unable to average much more than thirty pounds a piece while the weight of their own food reduces the 'pay-load' by every day away from their supply-base; besides a crowd of porters is a real disadvantage if one wishes to watch wild life. This is where elephants come in—one animal can carry the loads of twenty-five men, can live entirely on what grows in the forest[2] and, instead of being a handicap, is the greatest help in approaching wild animals which allow a pad elephant almost within touching distance ignoring its riders completely. Before the war two elephants were bought and two more caught and trained. One of these was shot during Japanese occupation but the remaining three with their Tharu mahouts would form the nucleus for a useful working herd. With a dozen elephants and perhaps a few saddle-ponies a fairly large number of visitors could enjoy trips in the park.

Given the elephants the only preparation necessary before this sort of touring could be started is to provide sufficient tents and camping gear, to clear a few camping sites (leaving all sound trees in the upper canopy of the forest), to repair and improve existing paths and to align new ones—work that could be extended almost indefinitely according to the success of the scheme. Where paths pass through *sladang* country it would be a good idea to remove the lower storey of the forest and clear the undergrowth to a width of a couple of chains on either side of the track. This light top-shade, as we found by small-scale experiments, encourages the carpet of short grasses (*Paspalum*, etc.) characteristic of the forest floor, without allowing the invasion of *lalang*, *tebrau* and other coarse grasses (*Imperata, Saccharum*, etc.). Though *sladang* eat the coarse grasses eagerly enough when tender shoots sprout after a fire, I believe that their principal food is the short grasses and that it is only by increasing the grazing that we can increase the herds.

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[1] See footnote, p. 559.

[2] Malaya is the best country for elephant-grazing that I have come across.

This, however, is not the place to elaborate detailed plans, still less to attempt to forecast the future in terms of profit and loss. Though I am all for caution and gradual expansion along lines found, by trial and error, to be profitable, I still believe that it would be cheaper, in the long run, to spend enough money in the next few years to make the park at least partially self-supporting, than to continue spending indefinitely the minimum that will keep its boundaries intact. It may be said that the present is no time to consider such amenities as national parks—with famine threatening half the world—the present moment is certainly no time for *spending* but it is never too soon to consider how to spend to the best advantage when times improve. If the *moment* is inopportune the *era* is all in our favour—times change quickly after a war; a new generation takes the stage, thousands who would never have seen a tropical forest in normal times have made its acquaintance through jungle warfare; and though the majority of ex-guerrillas may feel that they have had enough 'bush-whacking' for one lifetime, there will always be a minority who fall for the fascination of the jungle and would like to revisit it, at least for a spell, in peace and comfort. I have met some of them who felt like this and it is from among such that we shall recruit our future visitors and out future game-wardens.

The speed of modern travel can be relied on to make our potential 'audience' more and more a world-wide one; I should not be surprised if there is a demand for air-strips in the park before long—I think I know of two sites; one of them within reach of a reputed haunt of *Rhinoceros sondaicus* (if he is not already extinct on the Peninsula) at any rate near *R sumatrensis* country. Once inside the real jungle well away from human habitation, there was no malaria even in pre-war days; to-day, should it appear, D.D.T. around the affected camp would make short work of it. There is perfect site for a rest-camp or small hill-station on flattish land at about 4,000 ft. in the heart of one of the most attractive parts of the Park.

The necessities of jungle-warfare have led to improvements in every sort of equipment and the tents, hammocks and everything I saw with the para-troops when I came out of prison, were an eye-opener though I thought I had up-to-date views on camping-gear. Then again photography has not stood still—lighter cameras and cinés, faster lenses, more sensitive fine-grained film and, above all improvements in flash-light equipment have all made animal photography a very different matter to-day and it is likely to become one of the greatest attractions to the Park. Any modern camper of imagination will realize, far better than an old-timer can, what such things as the new fishing-tackle, the portable transmitters, the 'dropped' provisions and all the rest of the new-fangled benefits will mean to him. In short I believe that, with the changing times, the inaccessible, unwanted King George V National Park of Malaya has a future at last—if it is given a dog's chance.

THE SANDS HOUSE,
SOUTH NEWINGTON,
BANBURY, OXON,
ENGLAND,
20 *August*, 1946.

E. O. SHEBBEARE.

20.—A FIVE-BUNCHED INFLORESCENCE OF A BANANA (*MUSA PARADISIACA* LINN. VAR.)

(*With a plate.*)

The Plate shows a very interesting banana plant, a vegetable variety locally called 'monthan' (*Musa paradisiaca* Linn.) which was found at Colachel in South Travancore. While Jacob (1) has recorded a fasciated inflorescence of a normal banana producing a dozen different 'hearts', here is a case where five different bunches have developed from a single plant. The plant was quite normal for all outward appearances except for the very stout pseudo stem. Out of the five bunches three were big and well developed, each having a shot blade. The other two inflorescences formed a double bunch coming out of a common shot blade. It is interesting to note that all the bunches emerged simultaneously and in the same direction. A dissection of the pseudo stem showed that four distinct inflorescence-stalks had their independent origin from the underground rhizome, the thickest of which had forked into two after emergence. The suckers from this stock however failed to imitate the benevolent mother. The local people considered the plant to be sacred and divine.

Acknowledgment:—I express my great gratitude to the Government Lecturing and Systematic Botanist, Sri S. N. Chandra Sekara Iyer, M.A., for the encouragement and help he has given me in producing this note. Also my thanks are due to Mr. G. S. Money who was kind enough to take the photos.

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BOTANY SECTION,
MADRAS AGRICULTURAL COLLEGE AND
RESEARCH INSTITUTE, LAWLEY ROAD,
COIMBATORE.
18 *October*, 1946.

TRUPAPUR A. DAVIS,
Research Student.

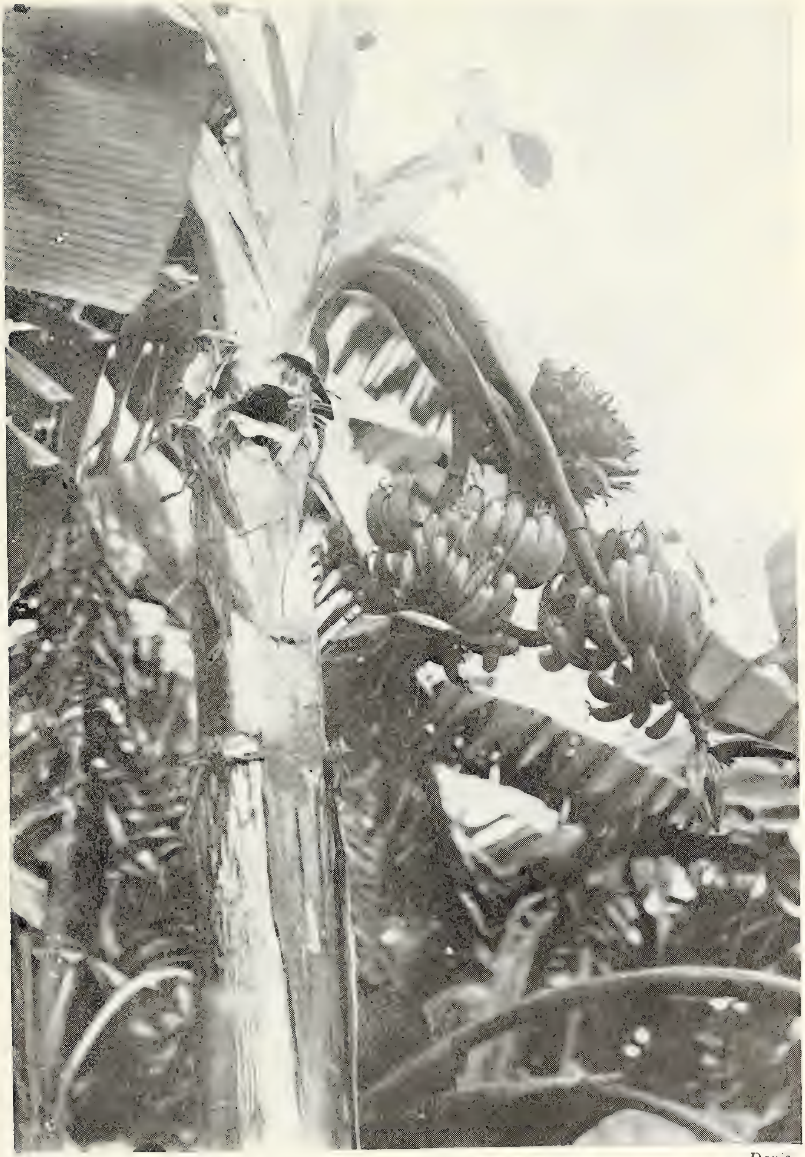

Photo by *Davis.*

Musa with 5 Bunches Monthan, Colachal, South Travancore.

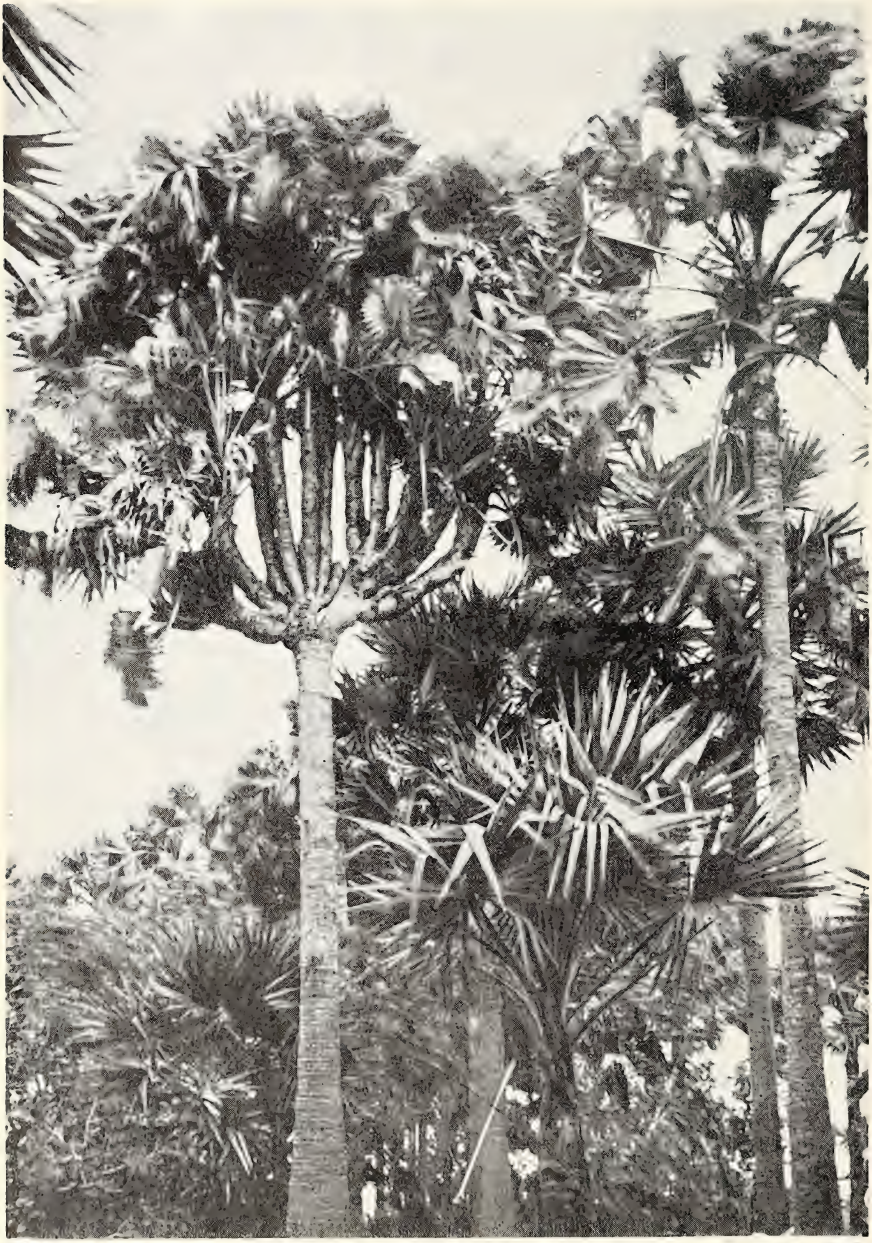

Photo by Davis.

A Multi-headed Palmyra, Muttom, South Travancore.

21.—A MULTI-HEADED PALMYRA (*BORASSUS FLABELLIFER* L.)

(*With a plate.*)

Branching in palms though a very rare phenomenon has been recorded in some cases. Jacob (1) and (2) has reported stem fasciation in Coconut and arecanut. Yegnanarayana Iyer (3) has recorded a coconut tree with two stems and another with seven branches. Wray (4) has reported a 'double coconut tree'. Palms like Indian Doum (*Borassus dichotoma* White) are normally dichotomously branched. However, not much is recorded about the branching of the common palmyra (*Borassus flabellifer* Linn.) During my tours, at places like Mannargudi, (Tanjore District) Vellaikoil and Tennalai (Coimbatore District) Tinnevelly near Tambarabarni river, Kallukutti (South Travancore), I have come across palmyras with two to five crowns. The Plate shows a monstrous palmyra with more than eighteen branches. The palm was quite normal up to twenty feet height after which it branched into two and again into a number of other branches. Twelve branches are fairly long and distinct each possessing a separate crown. Three of these branches again divide. The lower-most branch on the left side (Plate) gives rise to five more small heads. It is interesting to note that all the branches develop in a vertical plane. Visitors to Muttom, the Light House Station in South Travancore, can never miss this very interesting and rare freak.

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5. Rev. E. Blatter, S. J., 'The Palms of British India and Ceylon', page 157.
6. K. R. Srinivasan, 'Instance of Fasciation in Palmyra', *Bom. Nat. Hist. Soc.,* Vol. 46, 1946.

BOTANY SECTION,
MADRAS AGRICULTURAL COLLEGE AND RESEARCH INSTITUTE, LAWLEY ROAD,
COIMBATORE.
18 *October,* 1946.

TRUPAPUR A. DAVIS,
Research Student.

22.—VARIATION IN THE NUMBERS OF FLORAL PARTS IN *JASMINUM MALABARICUM* WT.

In my excursions about Khandala during the last six years, the variations in the flowers of *Jasminum malabaricum* Wt. have been a constant puzzle. This year during the month of April, when *Jasminum* was in full bloom and very abundant about St. Xavier's Villa, Khandala, I decided to study the question in detail in order to try and fix the limits of such variations.

Large numbers of flowers were at first collected by myself, and as far as possible, from different plants. Then, in order to avoid any personal bias on my part, I had the help of our Mali, St. Xavier's Villa, to do the collecting; his instructions were to collect one branch from every plant in flower which he could see in St. Xavier's Villa and Convalescent Home grounds; all our plants were, then, collected within an area of about one square mile, with St. Xavier's Villa as the centre.

After collection within the narrow limits indicated, all plants were taken to my improvised laboratory and their identification checked individually; all the specimens dealt with for the purposes of this enquiry belonged to *Jasminum malabaricum* Wt.; if there was any specimen that appeared in the least doubtful, it was put aside and left out of my calculations. One of the first results noted was a very large variation not only in the number of floral parts, but also in their structure, size, etc; in fact, about the only feature that seemed to be constant was the number of stamens, which in every flower examined was only two. In this note, however, I shall restrict myself to variation in numbers.

In the first part of my inquiry every calyx and corolla was counted independently, that is to say, first I counted all the corollas then all the calyxes; in this way about 3,000 flowers were examined. At a later stage, however, after noting some sort of correspondence between the numbers of calyx and corolla segments, I tried to discover the relation between such numbers; for this purpose about 600 new flowers were counted, and this brought the total of flowers examined to nearly 4000.

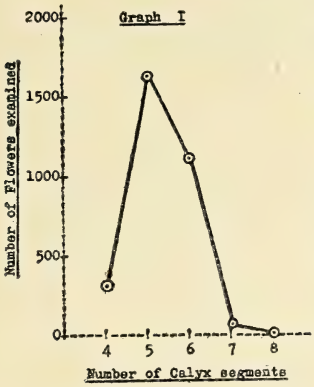
The task of counting so many flowers would have been altogether impossible for me, but for the kind help and assistance of the Rev. R. de Rafael, the Head of our Physics Department, with whose help and advice a method was deviced for dealing with large numbers of flowers in a relatively short time. The whole inquiry took from April 9th to April 15th of this year.

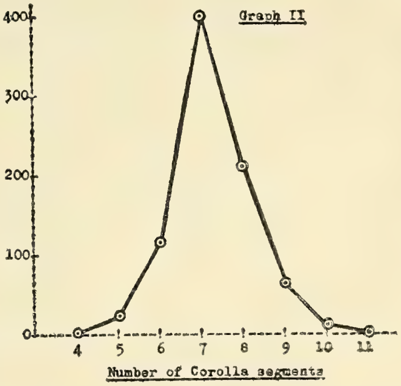
The following tables and graphs will give an idea of our results. The number of calyx segments was found to vary between 4 & 8, that of corolla segments between 4 & 11; the number of 3249 flowers counted for the calyx and 954 for the corolla seems ample enough to warrant our conclusions.

TABLE I

K/C	*No. Calyces examined*	*No. Corollas examined*
4	333	1
5	1,643	27
6	1,219	181
7	50	403
8	4	266
9	...	66
10	...	9
11	...	1
Total ..	3,249	154

Graphs Nos. I & II give a graphic representation of the distribution of calyx and corolla numbers; the structure of the graphs is clearly what one would expect from a normal distribution; this





is even more clear when the number of flowers examined is plotted not against the calyx or corolla numbers, but against their respective logarithms.

At this stage, as stated above, it was found desirable to correlate the numbers of calyx and corolla segments. As will be seen from Table II, whole flowers were counted, i.e., first the corolla, then the calyx and the results were at once put in tabular form.

TABLE II

Showing the Relation between Calyx and Corolla Numbers

TABLE II

NUMBER OF COROLLA SEGMENTS

	...	4	5	6	7	8	9	10	Total
NO. OF CALYX SEGMENTS	4	...	7	19	28	6	...	...	60
	5	1	8	90	161	71	16	3	350
	6	...	1	14	72	52	8	1	148
	7	...	..	...	1	3	1	...	5
	Total ...	1	16	123	262	132	25	4	563

Table No. II was submitted to Prof. D. D. Kosambi, the statistician on the staff of the Tata Institute of Fundamental Research, Bombay; after working out the correlation values between calyx and corolla numbers, he sent me the following answer: 'Correlations calculated both in the integral units as well as the suggested logarithmic units (Loge values for calyx and corolla numbers) . . . these values are respectively

$$r = 0.275 \text{ and}$$
$$r = 0.277$$

and the difference is barely significant. Both correlations, however, are highly significant indeed, though I do not know whether linkage is to be suspected between the two characters. This question of linkage which I suppose is most important from the geneticist's point of view, can only be settled by experiment. However, if you have reason to believe that the groups of plants from which specimens are observed are fairly close in geographical distribution and sensibly homozygous, I suggest that evidence exists to justify the hypothesis of linkage.' As a matter of interest, all our plants came from a very narrow area, and this coupled with the correlation between calyx and corolla numbers very strongly suggests the presence of linkage; this point, however, will have to be left out of this paper, as it goes beyond the limits of my inquiry.

Conclusions:

1. When the calyx and corolla segments are counted independently of each other, the most frequent numbers for calyx and corolla are 5 and 7 respectively.
2. When calyx and corolla are correlated among themselves, the same results are obtained, the most frequent combination being K 5, C 7.
3. In the case of calyx numbers, there is a high peak at K 5, and an almost equally high peak at K 6; outside these two figures, there is a very rapid decrease in either direction.
4. In the case of corolla numbers, there is a high peak at C 7, and from this figure there is a fairly gradual decrease in either direction.

St. Xavier's College,
Fort, Bombay,
15th *July*, 1946. H. SANTAPAU, S.J.

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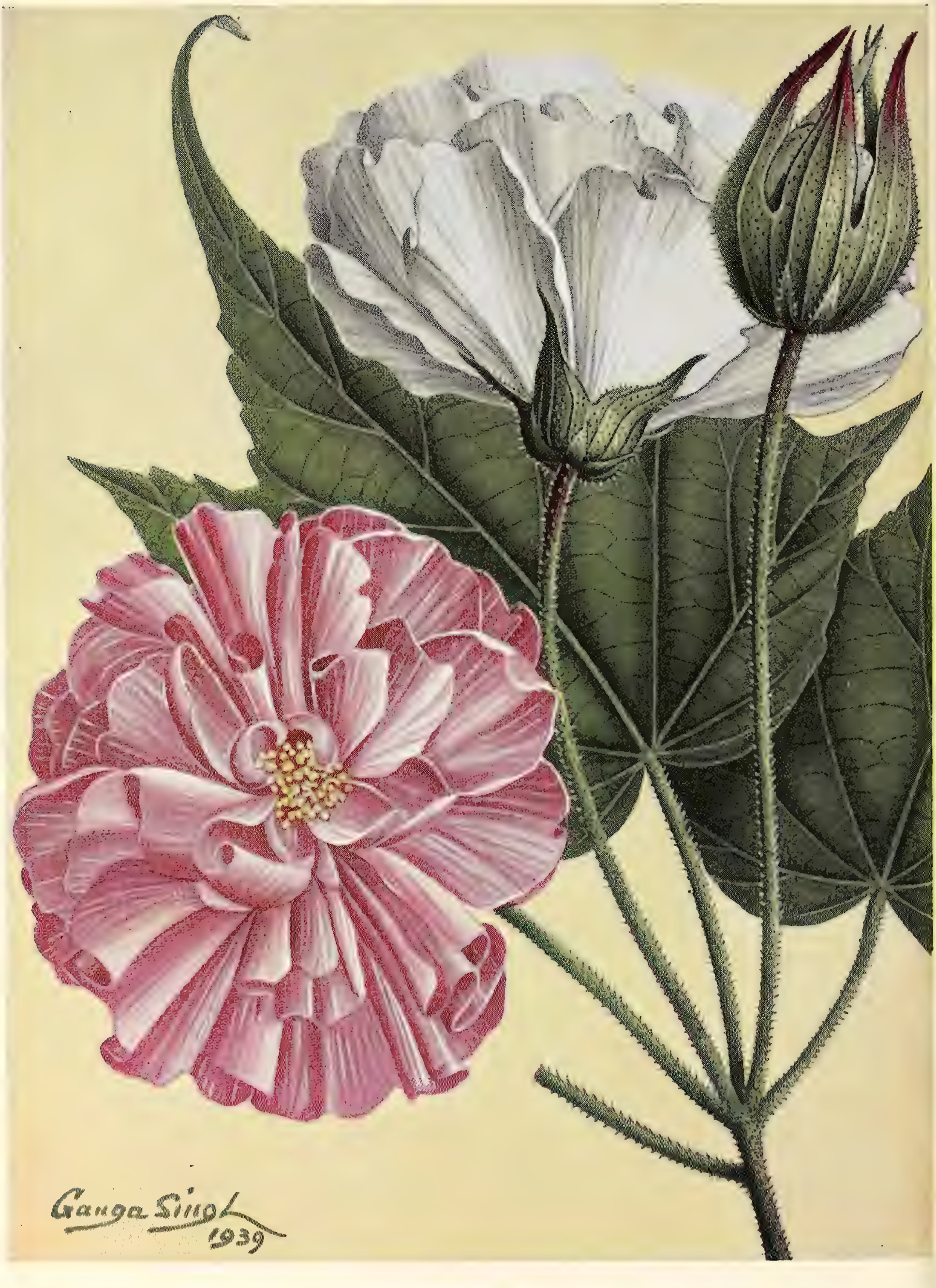
Ganga Singh
1939

Changeable Rose

HIBISCUS MUTABILIS LINN.
(nearly natural size)

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1947. VOL. 46. NO. 4

SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.

BY

N. L. BOR, C.I.E., M.A., D.SC., F.L.S., I.F.S.,

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AND

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PART XXV.

(*Continued from Vol.* 46 (1946), p. 413).

(*With one coloured and 6 black and white plates.*)

Malvaceae

This family, which takes its name from one of its genera, *Malva,* the Mallow, contains 42 genera with over 900 species and is confined, with few exceptions, to the tropics of both hemispheres.

The family comprises herbs, shrubs and trees. Mucilage cells either singly or in rows, occur in the bark and pith. The leaves are alternate and often more or less palmately divided but it frequently happens that both entire and palmately divided leaves are found on the same plant. Stipules are present, but they fall off early and leave a scar at the base of the petiole. Young parts are usually covered, sparsely or thickly, with hair. The pubescence in *Malvaceae* is termed stellate because the individual hairs are not single and simple but a number are attached to one point and radiate from it like the rays of a conventional star.

The flowers are usually large and showy and are most often solitary in the leaf-axils. Below the calyx is a structure known as an epicalyx, which in this family consists of a whorl of bracteoles.

The epicalyx functions as an extra protection for the young parts in the bud. The five, usually large and brightly coloured petals are twisted in the bud. They are free to the base where they are attached to the staminal-tube and fall with it when the flower withers. The stamens are numerous. The filaments are joined together into a complete tube which arises from the base of the petals and surrounds the filiform style. The top of the staminal-tube is usually produced upwards above the anthers and ends in a jagged or toothed edge. The anthers are kidney-shaped and 1-celled. The pollen-grains are large and spherical and adhere to one another in masses. The extine of the grain is covered with spines. The ovary is superior and generally 5-celled with many ovules attached to the inner angle of the cells. The style is long and filiform; stigmas the same number as or double the number of the carpels, capitate. The fruit is usually a dry capsule, very rarely fleshy, or a berry. The seeds are sometimes hairy.

The flowers of the *Malvaceae* are termed protandrous, i.e. the anthers mature earlier than the stigmas. When the petals untwist themselves the stigmas are hidden within the staminal-tube and the anthers mature and burst before the stigmas emerge. By the time the stigmas have emerged the anthers have turned downwards but the slimy spiny pollen-grains adhere for sometime to the dehisced anther-cells. There are five nectar pits on the inner surface of the calyx-tube; one between each pair of petals. The nectar is protected from the rain by the fringes at the bases of the petals. Insects which come to take the nectar carry away some of the pollen with them and transfer it to the stigma of an older flower. Some American species of *Hibiscus* are said to be cross-fertilised by birds. Although cross-fertilisation is the rule in these brightly coloured plants, self-fertilisation is quite a common phenomenon.

Many shrubby plants belonging to this family are cultivated in Indian gardens for the sake of their gorgeous flowers. *Hibiscus* is perhaps the best known genus but *Pavonia, Malvaviscus, Malvastrum, Thespesia* and *Gossypium,* as ornamental plants are by no means to be despised.

It has been mentioned above that the seeds of some species are enveloped in hairs. This is a device to secure wide dissemination of the seed. This characteristic of certain genera is of very great importance to mankind. For it is not too much to say that, if cotton, the hairy covering of the seeds of *Gossypium* was, not available to man, life as we know it, would be very different from that in a cottonless world. These long 1-celled hairs which can be spun into thread enter into a host of indispensable articles. It can also, as if to counteract its usefulness, be used to produce a devastating explosive.

Many of the species growing wild in India are well known for their possession of a very tough fibre which is developed in the bast. *Urena lobata,* a pretty pink-flowered untidy undershrub, is very common all over India in plains and hills. The fibre of this plant, which resembles flax, can be made into cloth, string-bags, fishing-lines, twine and so forth. Several species of *Abutilon,* another genus of *Malvaceae*, yield a fibre which has some repute but for which no commercial demand exists as yet.

Mucilage is found in large quantities in the roots, stems and leaves of certain species and this property led to their extended use as medicines in ancient times. A very considerable number of malvaceous species are mentioned by Dioscorides and by the herbalists of the seventeenth century. These species were prescribed in various ways as tonics, aperients, aphrodisiacs, palliatives and curatives for all sorts of diseases. The followers of Pythagoras considered that magical formulae, written upon the leaves of *Malva*, were far more potent than when written upon any other surface. This particular plant also has the dubious honour of being mentioned by the Latin poet Martial who in the following lines—

Exoneraturas ventrem mihi vilica malvas
Attulit et varias, quas habet hortus, opes.

sings of its virtues as a purgative.

Although members of the *Malvaceae* have been known in Europe since very early times, competent botanists consider that no malvaceous plant can be deemed beyond all doubt to be indigenous to Europe. As stated above the real home of the family is in the warmer regions of the earth.

Hibiscus Linn.

(This name is derived from *ebiskos*, *ibiskos*, Greek words used by Dioscorides to designate *Althaea officinalis*, the Marsh Mallow.)

Herbs, shrubs, climbers or trees: Leaves alternate, usually palmately lobed or cut; stipules early caducous. Flowers large, showy, axillary or rarely in a terminal raceme. Bracteoles below the calyx, 4-12 or rarely 0, usually free from one another and from the calyx; calyx bell-shaped, 5-lobed; lobes valvate. Petals 5, connate at the base and adnate to the staminal-tube. Staminal-tube 5-lobed or 5-toothed at the top, giving off the free ends of the stamens at different levels. Ovary 5-celled; ovules 3 or more in each cell; styles 5, connate below; stigmas capitate. Fruit a 5-valved or 5-celled capsule. Seeds reniform, globose or obovoid, glabrous, velvety, cottony or scaly.

This genus contains about 200 species of which a fair number are indigenous to India. Some of the indigenous species are used as food, some as medicines, while others are valued for the fibre which they yield. A few of these which are valued for some reason or another but not cultivated in gardens for show, are the following:—

Hibiscus abelmoschus Linn.

The Musk Mallow.

(Arabic *Hab-ul-mushk* from which the specific name is derived. The Sanskrit name is *Gandapura.*)

An annual or biennial plant found in the hotter parts of India. The seeds are musk-scented and contain an oil which is extensively used in native medicine; it is said to be antispasmodic, stomachic, diuretic and to be of value in venereal diseases.

Hibiscus cannabinus Linn.

Deccan Hemp, Ambari Hemp.

(Hind: Ambari).

A small herbaceous shrub which is extensively cultivated as a fibre crop outside the great jute areas. The fibre is said to be stronger than jute. The seeds contain an oil which is a good lubricant and illuminant. Burkill says it is suitable for the manufacture of linoleum paints.

Hibiscu esculentus Linn.

Ladies'-Fingers.

(Hind: Bhindi).

A tall herb cultivated everywhere in India for the sake of its young capsules which are largely eaten as a vegetable. Opinion as to the palatability of Ladies'-finger vary, some liking them, while others consider them to be absolutely revolting in the insipidity. The latter opinion is due to the amount of mucilage they contain which, when the vegetable is boiled, appears in large quantities. The unpleasant aspect of the vegetable can be got rid of by boiling the capsules in vinegar. The plant is also valued for its medicinal virtues. Decoction of various parts of the plant are used in venereal diseases.

Hibiscus sabdariffa Linn.

The Rozella or Red Sorrel.

(Hind: Patwa).

A shrub which is very extensively cultivated in India. It has red stems and a succulent, red, fleshy, edible calyx. The calyx can be made into jellies or preserves and has a very delicate flavour. The stem yields a fairly strong fibre.

A number of species of *Hibiscus* are cultivated in gardens for their very showy flowers. As always happens the horticulturists have bred, crossed, rebred and recrossed the various species until we have a bewildering set of names and colours among which the original species are almost lost. In the *Journal of the Bombay Natural History Society*, Vol. xx, 1906, p. 892, et seq. Mr. Millard gives a list of the varieties of *Hibiscus* as known to him at that time. He lists 7 double and 24 single varieties.

More recently Mrs. Robinson (*Jour. Bomb. Nat. Hist. Soc.*, Vol. xl, 1938, pp. 1-7), published a paper on the 'Raising of Hibiscus from seed' in which she discusses upon the many varieties of *Hibiscus*, their pollination, and other interesting themes.

It may interest readers to know that in Hawaii up to the year 1913 over 1000 crosses of *Hibiscus* were made. It is not too much to conclude that in the intervening years several thousand more might have been accomplished.

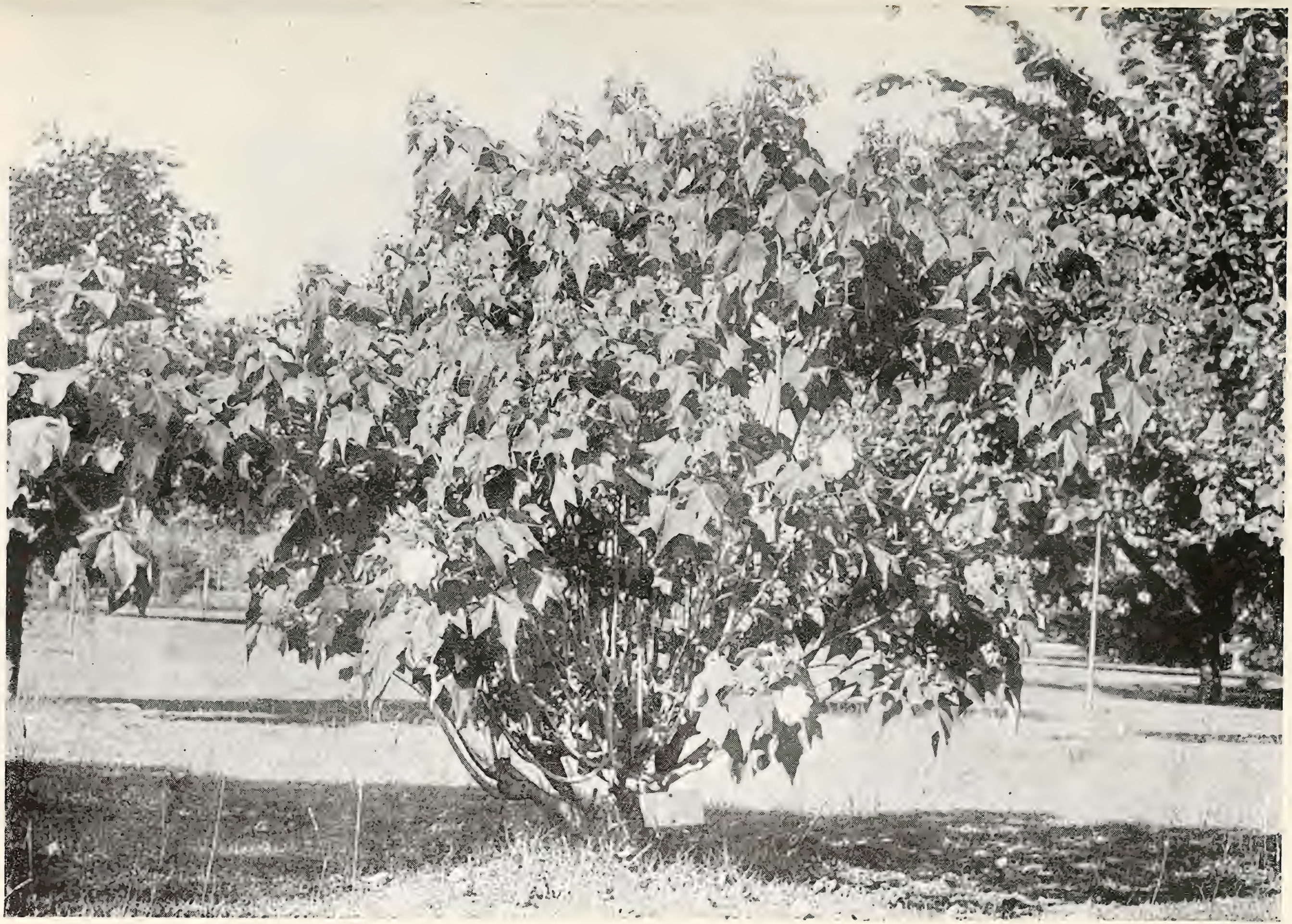

Photo by M. B. Raizada.

Changeable Rose.
Hibiscus mutabilis Linn.
New Forest, Dehra Dun.

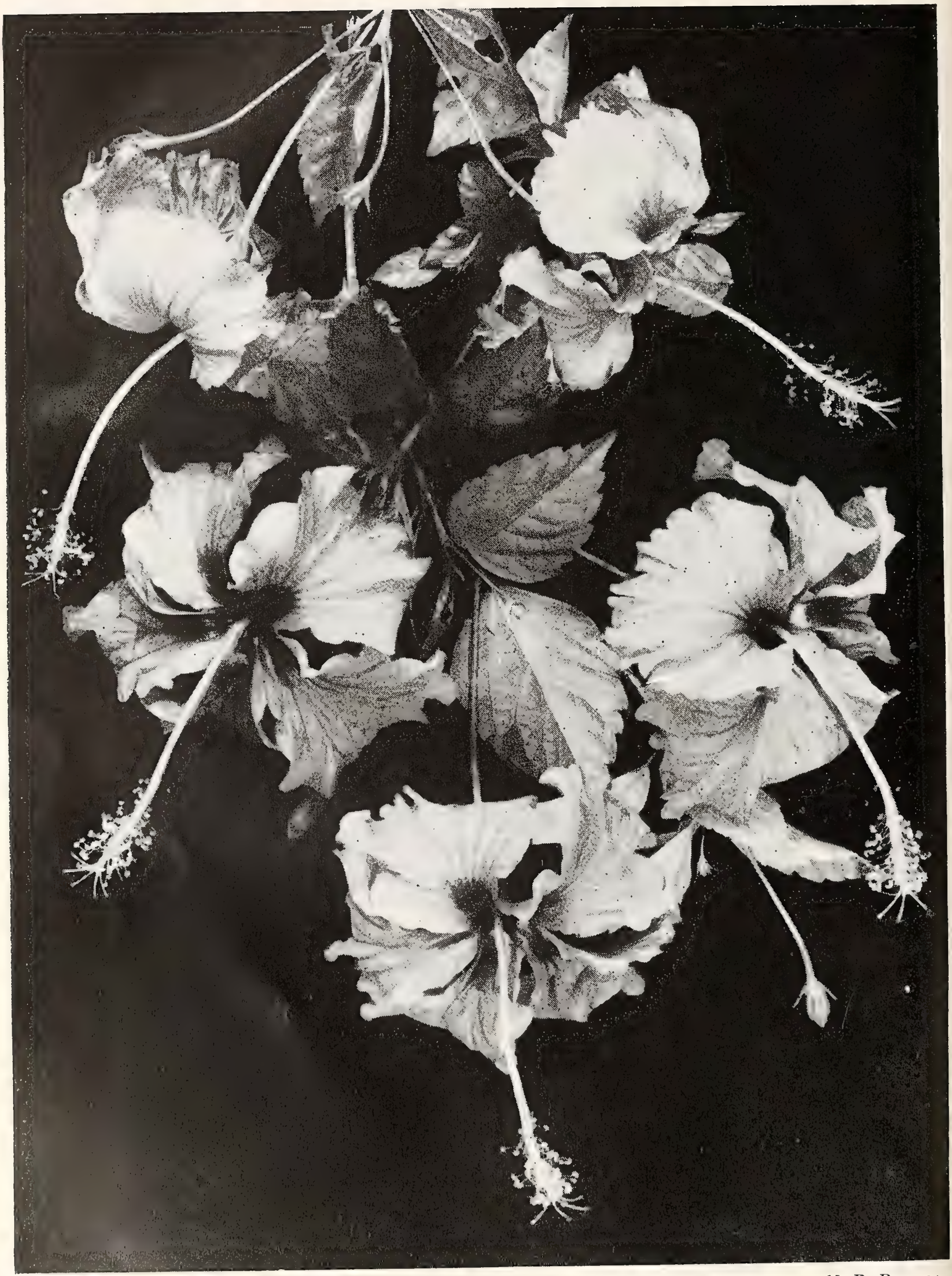

Photo by M. B. RAIZADA.

The Coral Hibiscus.
Hibiscus schizopetalus (Mast.) Hook. *f*.
New Forest, Dehra Dun.

When making a cross it is advisable that the unopened anthers of the female parent be cut away. This is accomplished by removing the petals of a bud that is going to open the next day. One can easily judge this by the size of the bud. Having removed the unopened anthers the staminal-column is placed in a pollen bag, i.e., a bag which prevents the transference of pollen to the stigmas through the agency of wind or insects. Dry pollen from the male parent should be deposited upon the receptive stigmas and the pollen bag replaced until the stigmas wither. As has already been mentioned the stigmas of certain species do not appear until the pollen has been shed several hours after the flower has opened. In such cases the anthers may be removed after the flower opens.

Seeds resulting from natural or artificial pollination are ripe in about 6 weeks. These seeds may be planted as soon as dry or they may be kept for some time as their viability is high. All seeds resulting from cross must be sown as the amount of variation resulting from a cross is considerable and all seedlings obtained must be raised in order to get material for propagation and for further crossing.

In Hawaii the seeds of *Hibiscus* are usually planted in pots ·25 in. deep in a 1 in. deep layer of coral sand or top of the soil. Seedlings are transplanted after 1 month when they are 2 in. high. When they reach a height of 5 in. they are again transplanted. The seedlings are said to flower from 9-12 months after the seed has been sown.

In order to perpetuate the desirable characters of the hybrid as revealed by the flowering of the seedling, these hybrids must be propagated by grafts or cuttings. Cuttings of well matured wood .5-1 in. diameter and 5 in. long do best. Cuttings should be planted 3 in. deep in sand and if the latter is kept well watered roots should form in 6 weeks.

With few exceptions all varieties are scentless. The flowers usually open in the early morning and stay fresh for about twelve hours or so. When picked, all varieties stay just as crisp and fresh with or without water. They are, therefore, not suitable for table decoration.

Most hibiscus plants flower best in the hot months, although a few blooms appear in off-season. The cultivation is easy and demands but little care and plants can easily be multiplied by cuttings, although the hybrids are often slow in striking. The plants lend themselves to a variety of uses: they will grow as shrubbery masses, either tall or short; they can be trimmed into hedges for which purpose the common single red, *H. rosa-sinensis* is the best; they will cover arbors and will even form standard trees.

Hibiscus are sun-loving plants and should not be planted in shade. They grow so rapidly that much pruning is necessary and it is the lack of such care that makes them so often look ragged and unsightly. The blooms occur on the new wood, so that heavy pruning also induces extra flowers. The plants prefer a deep rich soil and a good unfailing supply of moisture.

In this part of our series we shall only deal with the 'Undiluted' as it were, species to be found in our gardens. It is not possible to trace the innumerable hybrids which have been produced at various horticultural centres.

KEY TO THE SPECIES OF HIBISCUS.

- Flowers double, changing in colour from white to red. *H. mutabilis.*
- Flowers single or double, not changing as above.
  - Petals cut and lobed. *H. schizopetalus.*
  - Petals not cut, entire.
    - Stamens prominently exserted; flowers never lilac or purple *H. rosa-sinense.*
    - Stamens not exserted; flowers lilac, purple or blue. *H. syriacus.*

Hibiscus mutabilis Linn.

Changeable Rose.

(*Mutabilis* means changing in Latin, and refers to the flowers of the species which change colour from white to red during the course of the day.)

Description.—A deciduous shrub or small tree with brownish bark on the old stems; younger parts greenish covered with a stellate tomentum, among which are to be found erect simple, golden glandular hairs. Leaves alternate, petiolate, stipulate, 4-9 in. long and has broad, deeply cordate, 3-5-lobed, crenate on the lobes, stellate tomentose on both surfaces, but much more thickly on the lower surface, yellow glandular hairs present; middle lobe long, caudate, acute; petiole up to 9 in. long terete, tomentose; stipule linear-subulate.

Flowers large, single or double, 3-4 in. across, pedunculate, axillary; peduncles 2-3 in. long, terete, stellate-tomentose, glandular hairy, articulate about .3 in. below the flower. Epicalyx of 6-9 lanceolate, tomentose lobes; calyx bowl-shaped, yellowish-green, glandular hairy, 5-lobed; lobes triangular up to 1 in. long acute, valvate. Petals 5 or several times that number, orbicular, obovate, shortly clawed, white at first, fading to pink. 2-2.5 in. long, glabrous, becoming hairy below. In cases when the corolla is double the extra petals arise from the staminal-tube. Stamens numerous; anthers 1-celled. Ovary covered with a dense mat of short silver hairs. Capsule sub-globose, ·8 in. in diameter, hirsute, endocarp with dense white hairs. Seeds brown, densely bearded on one side.

Flowers.—Sept.-Oct. Fruits Oct.-Nov.

Distribution.—Roxburgh states that this plant is a native of China. It has, however, been cultivated in this country for a very long time as an ornamental shrub.

Gardening.—A very common large deciduous shrub with large heart-shaped leaves. During September and October it bears in constant succession, a profusion of large, handsome, usually double flowers, somewhat like an immense double rose, which are white as they open fading to a deep rose tint. Haines, however, states that the sequence of fading, white to red, does not always occur and that occasionally individual flowers are red or pink from the bud. Propagated by cuttings which root readily, or by seed for even the double-flowered form fruits freely in this country. It should be cut

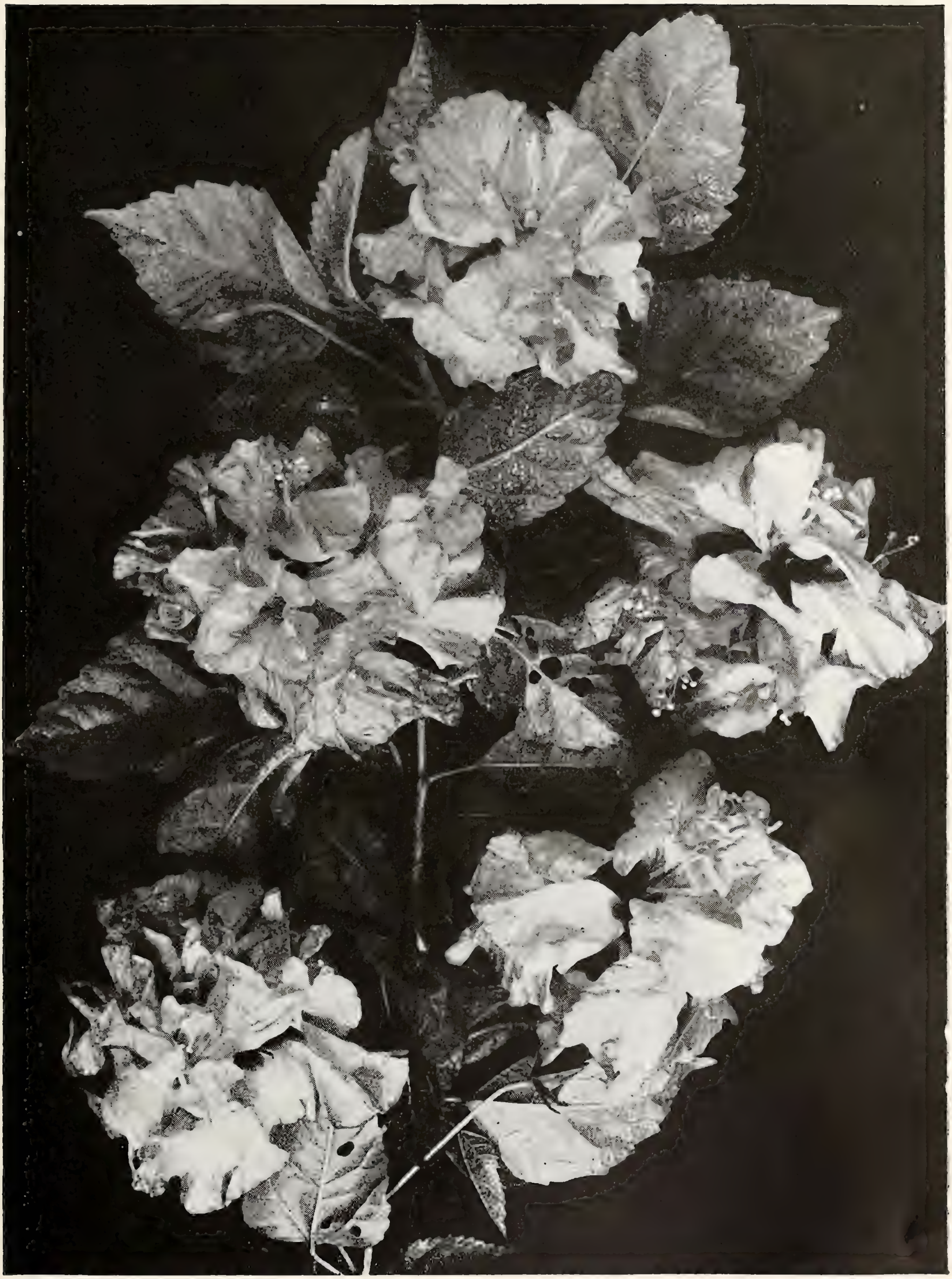

Photo by M. B. RAIZADA.

Chinese Shoe-flower.
Hibiscus rosa-sinensis Linn. (Double flowered form)
New Forest, Dehra Dun.

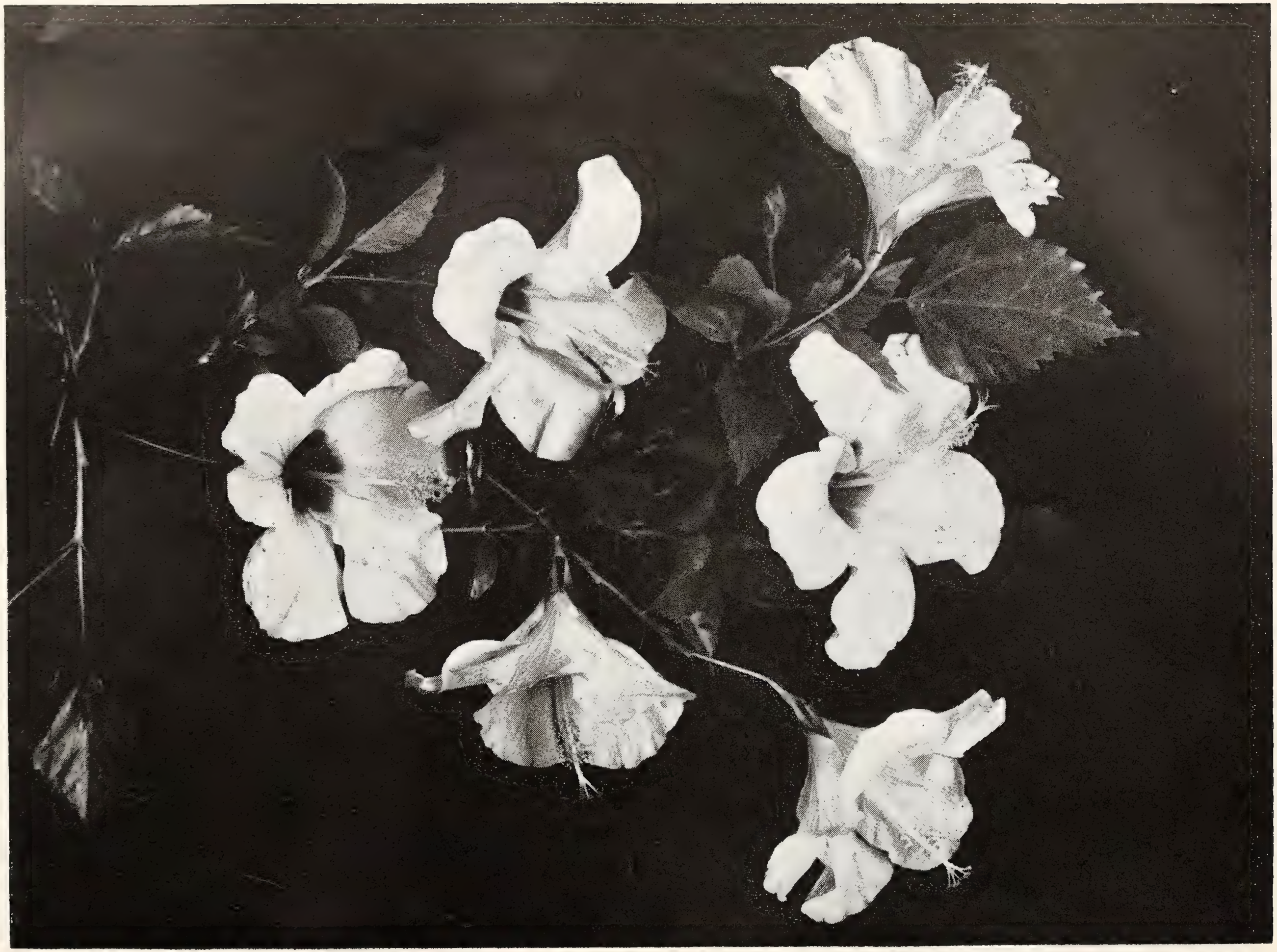

Photo by M. B. RAIZADA.

Chinese Shoe-flower.

Hibiscus rosa-sinensis Linn.

New Forest, Dehra Dun.

back after flowering. The shrub is not particularly ornamental when not in bloom. The flowers are, however, handsome and provide colour in the garden when it is badly needed. It is not particular in its soil requirements but insects sometimes attack it readily making it rather unsightly.

Hibiscus schizopetalus (Mast.) Hook.f.

'Coral Hibiscus.'

(*Schizopetalus* means split petals and refers to the beautifully cut and laciniate petals of this species.)

Description.—A glabrous shrub sometimes rambling. Leaves alternate, stipulate, petiolate, ovate or elliptic in shape, shining, crenate-serrate on the margins except at the base, 3-5-nerved from the base, 2-3.5 in. long; stipules minute, subulate, caducous; petiole .5-1 in. long.

Flowers axillary, drooping and fuchsia-like; peduncle 6 in. long, jointed in the middle, glabrous. Epicalyx of 7 minute, subulate bracteoles, or absent. Calyx .7 in. long, cylindrical spathaceous, at length split into 2-3 lobes; lobes obtuse. Petals 5, oblanceolate in outline, clawed, the margins beautifully cut or laciniate, of a deep crimson colour, reflexed, 2-3 in. long. Staminal-tube very long up to 6 in. in length, red, slender, divided at the top into an irregular number of lobes. Ovary pear-shaped, minutely hairy; style very long slender, dividing at the top into 5 long arms, each of which terminates in a capitate stigma. Fruit a long capsule, with smooth seeds.

Flowers.—April-Sept. Does not set seed in this country.

Distribution.—A native of tropical Africa; common in gardens throughout the country.

Gardening.—A large, evergreen, shrub with slender drooping branches. The flowers are red or orange-red, drooping and fuchsia-like, with the petals deeply cut and fringed. It was discovered by Dr. Kirk, Consul at Zanzibar who found it first in 1874 on the coast hills at Mombasa where it grows both in dry rocky slopes and in damp mountain glens, in dense shade, amongst bignonias, balsams, and ferns. Propagated by cuttings.

The coral hibiscus has been frequently crossed with other varieties and thus many of the newer sorts show a longer central column and petals more frilled than are found in ordinary kinds. The colour range also varies except that it is not blue or purple.

Hibiscus rosa-sinensis Linn.

Chinese Rose, Common Garden Hibiscus, Chinese Shoe-flower.

(The specific name refers to the origin of the plant.)

Description.—An evergreen shrub but in favourable situation reaching the dimensions of a small tree, glabrous (younger parts slightly pubescent). Leaves alternate, stipulate, petiolate, 2.5-5 in. long, ovate-acuminate, coarsely serrate, glabrous and shining, sometimes lobed, 3-nerved at the base; stipules ensiform or subulate; petiole up to 1 in. long.

Flowers solitary from the upper axils, pedunculate; peduncles longer than the petioles as long as the leaves, jointed .5 in. below the epicalyx. Epicalyx of 6-7 linear bracteoles shorter than the calyx, connate at the base, often with a few hairs along the margins. Calyx campanulate, including the lobes, 1.25 in. long, light green in colour with darker nerves, 5-lobed; lobes triangular-acute, .5 in. long. Petals 5, crimson, with a darker eye, obovate-obtuse, covered with short white hairs in the bud, afterwards glabrous, clawed, ciliate on the claw, up to 4 in. long by 2.5 in. wide at the broadest part. Staminal-tube 3.5 in. long or more, terminating above in short linear-acute lobes; stamens numerous; anthers 1-celled, yellow. Ovary conical, obtuse, .4 in. long, cream-coloured, covered with a very short erect pubescence. Style filiform, dividing into 5 branches .25 in. below the capitate red hairy stigmas. The fruit is a capsule up to .75 in. long.

The colour of the corolla of this species is extremely variable in cultivation. Double-flowered forms are common and in others the corolla may be magenta, cherry, bright red, yellow or striped white and red.

After the pollen has been shed the corolla begins to fade and wraps itself round the stamens and any pollen which may still be sticking to them. The stigmas are, however, still receptive and are guarded against self fertilisation. Sun birds certainly do aid in cross-fertilisation here.

Flowers.—Practically all the year round but profusely from April-September. Does not set seed in this country.

Distribution.—Probably a native of China, now common in all warm countries.

Gardening.—A large, evergreen showy shrub which is commonly cultivated for ornament throughout the tropics. It includes numerous single and double varieties, varying from very large brilliant crimson flowers, often 5.5 in. in diameter, through red to salmon-coloured and yellow flowers. It is a favourite ornamental bush and is commonly grown in gardens throughout the plains of India. Propagated by cuttings as the plant never seeds in this country.

Medicinal and Economic uses.—The flowers are considered refrigerant and emollient and an infusion of the petals is given as a demulcent. The leaves are said to be emollient, anodyne and laxative and the root is considered valuable in cough. According to Roxburgh the petals are used to blacken shoes, hence the English name of the plant. The Chinese are said to utilise them in the same way, and also to make a black dye for their hair and eyebrows from the petals. The bark yields a good fibre.

Hibiscus syriacus Linn.

Shrubby Althaea, Rose-of-Sharon.

(The specific name refers to the alleged native country of the plant.)

Description.—A shrub reaching 9 ft. in height, young parts covered with a soft sparse pubescence. Leaves alternate, petiolate,

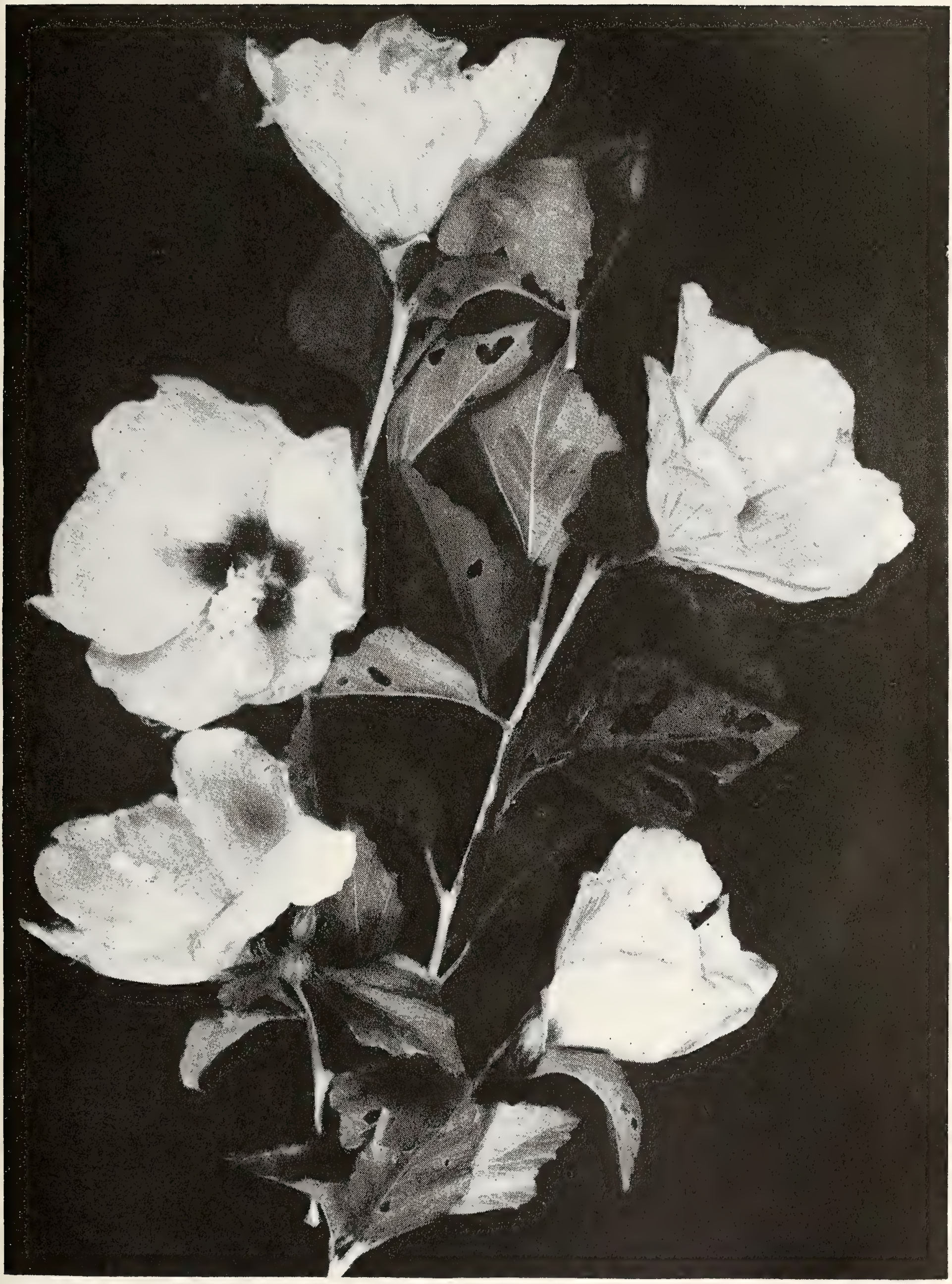

Photo by M. B. RAIZADA.

Rose of Sharon.
Hibiscus syriacus Linn.
New Forest, Dehra Dun.

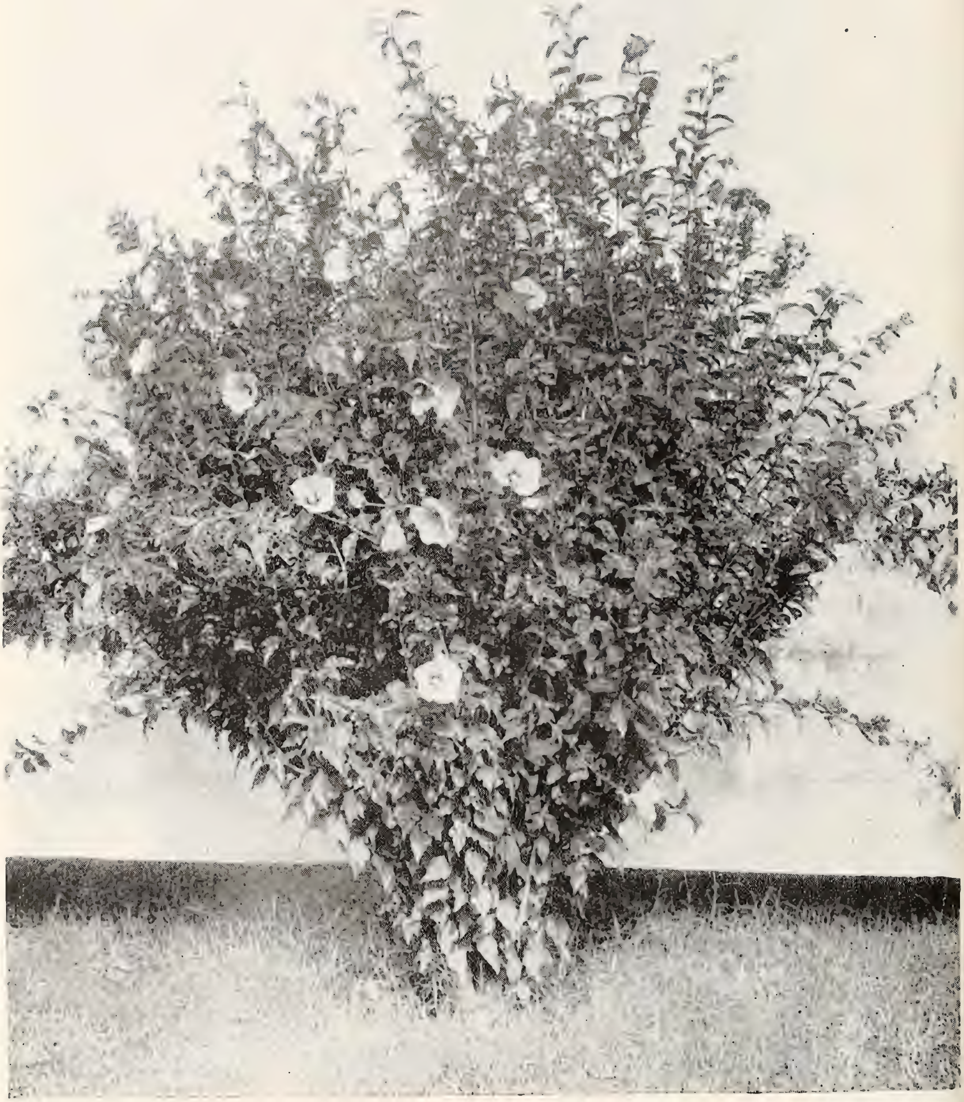

Photo by M. B. Raizada.

Rose of Sharon.
Hibiscus syriacus Linn.
New Forest, Dehra Dun.

stipulate, triangular, rhomboid, or rhomboid-ovate in shape, 5-nerved at the cuneate base of which 3 (the midrib and 2 lateral) are strongly marked, glabrous on both surfaces or with a few scattered tufts of stellate pubescence; 2-3 in. long; margins with crenate teeth in the upper two-thirds; petiole up to 1 in. long; stipules minute.

Flowers axillary, solitary, seated on stout peduncles which are shorter than the petioles. Epicalyx consisting of 6-7 sp. linear, narrow lobes, shorter than the calyx. Calyx bowl-shaped with the lobes .75 in. long, 5-lobed; lobes triangular acute, valvate in the bud, stellate-tomentose outside. Petals 5, pale purple or white, orbicular, clawed, 2 in. long by 2.5 in. wide at the broadest part, ciliate with white hairs. Staminal-tube short, not exserted, about 1.5 in. long, white or very pale purple. Ovary pubescent; style filiform; stigma white. The species is also extremely variable as regards the colour of its flowers; purple-pink, deep-purple, white, violet-red and pink forms are all met with.

Flowers.—June-August. Does not seed in this country.

Distribution.—Native country uncertain, but probably not Syria as Linnaeus supposed, now commonly cultivated in the plains and in hill stations throughout India.

Gardening.—A deciduous shrub which is immensely variable in character of flowers, the colour ranging from blue-purple to violet-red, flesh-colour and white; also in full double forms. Like other species of *Hibiscus* it will grow in any good soil, but thrives best in the hills and cooler plains districts. This species is of slender habit and the growth is thinner than with the majority of other species. Propagated easily by cuttings.

THE EARLY STAGES OF INDIAN LEPIDOPTERA.

BY

D. G. SEVASTOPULO, F.R.E.S.

PART XVII.

(*Continued from Vol.* 46, p. 430.)

RHOPALOCERA.

PAPILIONIDAE.

Papilio polytes L., *romulus* Cr.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xliv, 78. 1943.

Ovum—Spherical, the base flattened. Clear lemon yellow. Under a lens, the chlorion very slightly pebbled. Laid singly on the upper, or under, surface of a leaf of the food-plant.

Described from ova found in Calcutta in September 1944.

Talbot, quoting Bell, describes the ovum as being 'spherical, hardly perceptibly rough on the surface. Pale orange, opaque, shiny, smudged with pale brown. Diameter 1.2 mm.'

Papilio demoleus L., *demoleus*.

Talbot, *Fauna Brit. Ind.*, Butterflies, i (2nd edit.), 188. 1939.
Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xlv, 189. 1945.

Ovum—Spherical, the base flattened. Pale greenish yellow. Under a lens, the chlorion very slightly pebbled. Laid singly on the upper, or under, surface of a leaf of the food-plant. Smaller than the ovum of *P. polytes*.

Described from ova found in Calcutta in September 1944.

Talbot describes the ovum as pale yellow.

PIERIDAE.

Delias eucharis Drury.

Horsf. & Moore, *Cat. Lep. E. I. Co.*, 80, pl. 1, figs. 1, 1*a*. 1857.
Moore, *Lep. Ceyl.*, i, 140, pl. 54, fig. 1b. 1881.
Forsayeth, *Trans. Ent. Soc. Lond.*, iii, 337, 385. 1884.
Davidson & Aitken, *Journ. Bomb. Nat. Hist. Soc.*, v, 358 1890.
Moore, *Lep. Ind.*, iv, 175, pl. 534, figs. 1, 1a-d. 1904.
Bingham, *Fauna Brit. Ind.*, Butterflies, ii, 142. 1907.
Bell, *Journ. Bomb. Nat. Hist. Soc.*, xxi, 1149, pl. 1, fig. 17. 1912.
Ghosh, *Mem. Dep. Agr. Ind.*, Ent., ser. 5 (i), 27, pl. iii, figs. 1-4. 1914.
Talbot, *Monograph of Delias*, 497, pl. liii, fig. 6. 1937.
Talbot, *Fauna Brit. Ind.*, Butterflies, i, (2nd edit.), 355, pl. iii, figs. 1, 2. 1939.

Pupa—Head with a short forward-pointing snout and a short erect tooth above the base of the antenna. Thorax keeled with a slight depression between the pro- and meso-thorax. A slight projection at the origin of the wing cases. Abdominal somites with a slight dorsal crest and with a dorsal series of six spines, of which the fourth is the largest. A subdorsal series of very small spines, one each on the meso- and meta-thorax, and seven on the abdomen. A series of eight short spines just above the wing cases, one each on the meso- and meta-thorax, and six on the abdomen. Colour a clear, bright, lemon yellow. The cephalic snout, the dorsal spines and the first, second, fourth and sixth abdominal spines above the wing cases black. The keel at the front of the meso-thorax marked with a black patch. Wing cases marked with black along the costal margin, the outer margin with a black line, just within which is a series of seven conical black spots. Eye, leg and antenna sheaths marked with black. Venter blotched with black. Cremaster black with a transverse black dorsal bar just anterior to it. Suspended, usually in a vertical position, by a girdle and tail pad of white silk.

Described from a pupa found in Calcutta 19-ii-44, from which a male emerged 23-ii-44.

Bingham, quoting Davidson & Aitken, describes the ground colour as bright yellow; Talbot, quoting Bell, as 'slightly greenish light yellow' and his figure in the Fauna of British India shews an almost apple green pupa. All the pupae I have seen have had no trace of any green coloration.

NYMPHALIDAE.

Atella phalanta Drury.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xliii, 40. 1940.

Another form has the head brownish yellow, the clypeus outlined with black and filled in with white, and with a black spot on either side. Ground colour of body purple brown, minutely white-speckled, and with a double, pale, dorsal line. A zig-zag cream sublateral stripe. Spines black in some examples, pale pinkish in others. Venter purple brown on the thoracic somites, pinkish on the abdominal. Legs black. Prolegs pinkish. Spiracles black ringed with white.

Another form of pupa is leaf green with all the spines metallic silver tipped with red. A silver spot on the eye and a silver streak along the inner and outer margin of the wing case, both streaks and spots marked above with a red line. The amount of silver varies considerably, it being almost obsolete on some pupae.

Described from a full fed larva found in Calcutta 9-iii-44, pupated 12-iii-44 and a female emerged 17-iii-44.

LYCAENIDAE.

Zizeeria maha Koll., *maha*

Ovum—Button shaped and intricately sculptured. Colour bluish white. Laid singly on the underside of a leaf of the food-plant.

Larva—Head black, retractile. 1st somite retractile. Ground colour dull green, with an indistinct darker dorsal line. Segments fairly deeply cut. Clothed with moderately long, whitish pubescence.

Pupa formed on a leaf, resting on a carpet of white silk and supported by a girdle. Typical Lycaenid pupa in shape, the head and anal end obtuse, the division between the thorax and abdomen not very deep. Colour yellow green, the wing cases and a dorsal line darker. Except for the wing cases, clothed with short white pubescence.

Food-plant—*Oxalis corniculata* L.

Described from a full fed larva found in Calcutta 14-iii-44, pupated 17-iii-44 and a female emerged 23-iii-44.

Rathinda amor F.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xl, 399. 1938.

Another form has the ground colour pale yellowish green, the tips of the projections dull brown. A transverse line joining the lateral projections on the 5th somite, and a subdorsal line on the 6th to 8th somites brown.

A fuller description of the pupa is as follows. Shaped very like that of a Syrphid but somewhat humped just before the thorax. Attached to a leaf or twig by the cremaster. Colour bright green, the head, thorax and wing cases slightly darker, and with a narrow triangular chestnut, or dull brown, dorsal mark on the abdominal somites.

Food-plant—*Nephelium litchi.*

Described from a full fed larva found in Calcutta 14-iii-44, pupated 18-iii-44 and a female emerged 26-iii-44.

HETEROCERA

LASIOCAMPIDAE.

Estigena pardalis Wlk.

Ovum—Egg-shaped, slightly flattened at the sides. Colour chalky white, a diffused olive brown blotch surrounded by a broken, olive brown ring on the side and an olive brown spot at the end opposite the micropyle. The micropyle itself an olive spot. Under a lens, minutely punctuate. Laid singly, or in twos and threes, on a leaf or twig of the food-plant. Hatched 16-ii-44.

1st instar—Head and body dark grey. 2nd and 3rd somites each with a dark transverse dorsal band, 4th somite backwards with a subdorsal black spot edged above with orange. A lateral series of tufts of short hair and a dorsal series of tufts of longer, coarser, black hair. Shape tapered from head to anal claspers.

2nd instar—Very similar, the lateral tufts larger. 2nd somite with a dark, velvety, transverse slit with a tuft of short orange bristles in front; 3rd somite with a transverse blue band with a black spot at each end. 11th somite with a double orange dorsal wart.

3rd instar—Very similar. The lateral tufts springing from tubercles, those on the thoracic somites larger than on the abdominal. Abdominal somites with a dorsal series of four red spots arranged in a quadrilateral in place of the orange and black subdorsal spots.

4th instar—Head brownish grey, streaked with darker. Ground colour of body brownish grey minutely speckled with black. 2nd somite with a transverse dorsal slit, lined with velvety black skin and filled with black bristles, the anterior margin armed with buff bristles and with a slight edging of similar bristles posteriorly. 3rd somite with a transverse dorsal slit, lined with dark blue and edged, before and behind, with black bristles. 4th to 10th somites each with an anterior and posterior pair of red dots on the dorsum. 11th somite with a double dorsal wart clothed with short buff bristles. A series of sublateral tubercles tufted with pale brown hair, those on the thoracic somites considerably larger and that on the 1st somite double. Legs dark purplish brown. Venter brownish grey with a median blackish stripe, the undersurface of the sublateral tubercles, except on the 6th to 9th somites, blackish.

Final instar—Similar to preceding, except that the transverse slit on the 3rd somite is lined with black instead of blue. Ground colour sometimes somewhat mottled, in which case the 8th and 11th somites have a dark dorsal blotch. The warts on the 11th somite larger and clothed with buff scales. Spiracles buff ringed with black.

Pupa in a longish cylindrical cocoon with blunt ends, spun of soft pale silk and heavily impregnated by, but not stiffened with, a whitish chalky substance. Pupa pale olive brown, apparently smooth but so covered with the white chalky substance that it appears pubescent. Spiracles dark.

Food-plant—*Carissa carandas* L.

Described from larvae bred from ova found in Calcutta, one of which spun 16-iii-44 and a male emerged 25-iii-44.

SPHINGIDAE.

Acherontia lachesis F.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xlvi, 63. 1946.

Ovum—Pale green slightly tinged with orange. Ovoid in shape, very minutely pebbled. Laid singly on the upper or under surface of a leaf of the food-plant. Hatched 29-viii-44.

1st instar—Head rounded, pale green. Body pale green, becoming darker after feeding, a few short colourless hairs. Horn black, long and straight, the tip bifid. Moulted 2-ix-44.

2nd instar—Similar, the dorsum rather bluer green. Head and thorax with raised granules. Later in the instar oblique blue lateral stripes appear from the 4th somite backwards. Horn tuberculate. Moulted 5-ix-44.

3rd instar—Head green, with a paler V-shaped mark from vertex to each side of the mandibles, covered with raised granules. Body yellow green, a darker green dorsal stripe and a lateral series of oblique blue stripes, edged below with whitish, from 4th somite backwards. Horn long, straight, yellow green with black tubercles, the tip black and bifid. Legs pale lilac. Spiracles black. Thoracic somites with pronounced raised yellow granules, the rest of the body with less pronounced shagreening. Moulted 7-ix-44.

4th instar—Very similar to preceding. Head with a black stripe behind the arms of the pale V. Body without the darker green dorsal stripe, the abdominal somites with dark bluish specks on the secondary segmental divisions dorsally. Thoracic somites with the secondary divisions forming raised ridges and bearing raised yellow tubercles. The lateral stripes more pronounced. Legs black with whitish tubercles. Horn long, slightly upcurved at the end, green, shading into yellow apically, and bearing large tubercles. Moulted 10-ix-44.

Final instar—Yellow form—Similar to the green form (Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xliv, 419. 1944) but the ground colour a slightly greenish yellow and the blue of the dorsal dots and above the lateral stripes replaced by mauve. Buried 16-ix-44.

One larva was a distinctly bluer green in the 3rd and 4th instars and had the whitish edging of the oblique lateral stripes expanded into triangular patches. The final instar, however, was the usual yellow form.

Described from larvae bred from ova found in Calcutta.

Bell & Scott give the following description of the early instars:—'1st instar—Head and body pale yellow; horn black, long, straight, bifid. In the succeeding instars, head and body green, horn green;

pale yellow oblique stripes develop, and pointed tubercles which disappear in the fourth instar. A grey and a canary-yellow, as well as the green, form may appear in the third instar.'

Acherontia styx Westw., *styx*.

Moore, *Lep. Ceyl.*, ii, 7, pl. 76, fig. 1b. 1882-83.
Hamps., *Fauna Brit. Ind.*, Moths, i, 67. 1892.
Seitz, *Seitz Indo-Austr. Bombyces*, x, 527. 1928.
Bell & Scott, *Fauna Brit. Ind.*, Moths, v, 59, pl. viii, figs. 1, 2. 1937.

Ovum—Pale yellow green, a very short ovoid in shape. Much smaller than that of *A. lachesis* F. Under a lens the chlorion very minutely pebbled. Laid singly on the upper or under surface of a leaf of the food-plant. Hatched 24-ix-44.

1st instar—Head round, pale green. Body pale green, becoming darker after feeding. Horn straight, black, of medium length only, the tip bifid. Moulted 27-ix-44.

2nd instar—Very similar. The head and body studded with white granules, those on the body placed along the secondary segmental divisions. Horn tuberculate. Later in the instar oblique white lateral stripes from the 4th somite backward appear. Moulted 29-ix-44.

3rd instar—Very similar, the white lateral stripes more prominent and faintly edged above with blue. A darker green dorsal stripe. Horn green, the basal half purplish above, studded with small tubercles, the tip bifid. Legs pale pink. Later in the instar the area below the lateral stripes becomes suffused with bluish white. Moulted 1-x-44.

4th instar—Very similar. The head with a pale stripe from vertex to outside the jaws. The upper blue edging of the lateral stripes almost meeting dorsally and the white continued on the somite behind as a yellow line. Moulted 3-x-44.

Final instar—Head green with a black stripe along the cheek. Body with the thoracic somites yellow green, the 4th somite backwards rather bluer green and with dark blue dots along the secondary segmental divisions dorsally, and with a diffuse yellow spot on the anterior edge of each somite. 4th to 10th somites with a lateral series of oblique stripes, which continue almost to meet on the dorsum of the somite behind, these stripes cream shading into yellow in the dorsal portion and edged above with dark purplish blue, the stripe on the 10th somite extending to the base of the horn. Horn yellow, tuberculate, rather short and straight, the tip slightly curved down and then up. Spiracles white with the central slit black. Legs black ringed with white. Buried 7-x-44.

There are also yellow and brown forms but I have not bred them.

Pupa in a subterranean cell, the walls secured by pressure and not by silk. Bright mahogany brown, the abdominal somites with a diffused dark dorsal line. Meta-thorax with a subdorsal triangular patch of very rugose, dark cuticle. Cremaster black, triangular, rugose and ending in a bifid spine. Spiracles small and black. A male emerged 23-x-44.

Food-plant—My ova were found on Jasmine and the larvae fed up thereon. Bell & Scott give the following list:—*Dolichos lablab, Eugenia jambolana, Coccinia, Jasminum* spp., *Nyctanthes, Solanum* spp., *Datura, Bignonia megapotamica, Tecoma stans, Sesamum indicum, Vitex negundo, Clerodendron* spp., *Citharexylum subserratum, Coleus.* Seitz gives *Ligustrum lucidum* in China.

Described from larvae bred from ova found in Calcutta.

The earlier descriptions are very brief. Hampson, for instance, gives 'green, with oblique lateral yellow streaks on somites 4—10', and Moore is little better. Seitz also gives a very brief description and adds 'the larva often found in wandering, betraying itself by cracking with its mandibles.'

Nephele didyma F.

Moore, *Lep. Ceyl.*, ii, 2, pl. 72, fig. 1b. 1882-3.

Hamps., *Fauna Brit. Ind.*, Moths, i, 108. 1892.

Bell & Scott, *Fauna Brit. Ind.*, Moths, v, 326, pl. iv, figs. 13, 14. 1937.

Ovum—Almost spherical. Bright emerald green. Laid singly on new leaves of the food-plant. Hatched 9-iii-44.

1st instar—Head yellow green. Body yellow green, becoming darker after feeding. The intersegmental areas yellow. A slight crimson suffusion dorsally just anterior to the horn. Horn black, erect, the tip minutely bifid. A few very short black hairs on the body. Moulted 11-iii-44.

2nd instar—Very similar, ground colour green speckled minutely with yellow. A faint white subdorsal line from 6th somite to base of horn, more evident towards the end of the instar. Red suffusion extended slightly further forward along the dorsum. Brown form—Head orange brown, ground colour of body dull olive brown, the markings as in the green form. Moulted 13-iii-44.

3rd instar—Very similar to preceding. Traces of a pale oblique stripe running from below the spiracle on the 4th and 5th somites to the subdorsal area of the somite behind, the posterior stripe more prominent and sometimes reticulated about midway with purple. A dark dorsal line. A pale median line from 1st to 5th somite on the venter. Legs purplish. Spiracles black. Horn very dark reddish brown. Brown form—Similar to the green except that the ground colour is purplish brown and the pale markings are slightly tinged with pinkish. Moulted 15-iii-44.

4th instar—Very similar. The oblique stripe on the 5th-6th somite white, that on the 4th-5th obsolescent. An indistinct white stripe from the subdorsal line on the 10th somite to the anterior edge of the anal clasper. Brown form—Marked similarly but the lateral area below the subdorsal line very much darker than the dorsum, and the angle formed by the subdorsal line and the oblique stripe from the 10th somite filled in with pale lavender. Moulted 17-iii-44.

Final instar—Green form—Head green. Body green minutely speckled with yellow. A dark dorsal line. A yellowish white subdorsal line from the middle of the 6th somite to the base of the horn, becoming wider and clearer as it approaches the horn. A faint pale oblique stripe running from the spiracle of the 4th somite to the subdorsal area of the 5th and terminating in a white dot. A parallel stripe running from below the spiracle of the 5th somite to the subdorsal area of the 6th, the portion below the subdorsal line wider and whiter, and veined with purple. A pale stripe joining the subdorsal line at the anterior margin of the 10th somite and running to the origin of the anal proleg, the angle so formed suffused with whitish. Venter with a whitish median line. Spiracles mauve ringed with buff. Legs lavender with a dark stripe along the anterior edge. Prolegs green, the feet lavender. Horn slightly downcurved, of medium length and ending in a small conical point, deep lavender and minutely tuberculate. Brown form—Marked similarly, but the ground colour a deep tobacco brown, sometimes tinged with olive, and the subdorsal line and oblique stripe to the anal clasper pinkish white, the angle formed between them suffused with pinkish. In some examples the oblique stripes are more prominent than in others. Resting position with the forepart of the body raised. Before pupation becomes slightly suffused with pink. Pupated 25-iii-44.

Pupa in a slight cocoon amongst litter on the surface of the soil. Shape slender, the proboscis sheath extended forward and shaped like a duck's bill. Head, proboscis sheath and wing cases pale pinkish brown, the latter with indistinct dark transverse bars. Thorax and abdomen purple brown, the former somewhat paler, a dark dorsal line from base of the proboscis sheath to the cremaster, and a pale subdorsal line on the abdomen. The area below the subdorsal line dark purple brown. Venter pinkish brown, a pale line separating the ventral and lateral areas, and with traces of a dark median line. Cremaster ending in two conical points, a central furrow on the ventral surface. A male emerged 8-iv-44.

Food-plant—*Carissa carandas* L.

Described from larvae bred from ova found in Calcutta.

Hampson's description is 'green, with a pale stripe from 7th to 11th somites'. Moore describes it as follows:—Larva. Young.—Olive-green, minutely dotted with olive-brown; from 4th segment a dorsal row of slender oblique violet-brown streaks, below which is a longitudinal line extending to tip of horn; a reversely oblique violet-brown streak also on 7th to 11th segment; spiracles black. Adult—green, with an oblique pale-bordered stripe on 3rd to 5th segment and a longitudinal line from 8th segment to base of horn; spiracles black. Pupa pale dull red; wing cases with a few dusky spots; abdominal segments minutely spotted, and a lateral darker streak; spiracles and caudal spine black.' Bell & Scott describe the first instar larva as honey-yellow.

Theretra clotho Drury, *clotho*.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xlvi, 63. 1946.

1st instar—Head greenish yellow. Body greenish yellow, becoming greener after feeding. Horn black, long, thin and straight, the tip bifid. Fore-part of body slightly tapered. Moulted 28-x-44.

2nd instar—Head yellow green. Body green with a subdorsal yellowish line. 4th somite with a subdorsal ocellus consisting of a black pupil in a white ring. Horn with an orange spot at base, the rest black, long, thin and straight, the tip bifid. Moulted 30-x-44.

3rd instar—Ocellated green form—Similar to the unocellated. But 5th to 10th somites each bearing a subdorsal ocellus consisting of a white bar edged above and below with dark blue, these ocelli decreasing in size and becoming more rounded from front to rear. Moulted 2-xi-44.

4th instar—Ocellated green form—Similar to the unocellated form except for the extra ocelli, which are cream edged with dark blue, and otherwise similar to the preceding instar. Moulted 5-xi-44.

Final instar—Ocellated green form—Similar to the unocellated, with the exception of the additional ocelli on the 5th to 10th somites, consisting of a cream pupil ringed with dark blue, shape oval, becoming rounder and smaller from front to rear.

Described from larvæ found in Calcutta.

NOTODONTIDAE.

Stauropus alternus Wlk.

Moore, *Lep. Ceyl.*, ii, 110, pl. 119, fig. 1b. 1882-3.
Hamps., *Fauna Brit. Ind.*, Moths, i, 150. 1892.
Gardner, *Ind. Journ. Ent.*, v, 97. 1944.

Ovum—Round, flattened above and below, porcelain white, the micropyle a dark dot. Laid in ones and twos on the lower surface of a leaf of the food-plant.

1st instar—Head large, dark brown, shining. Body dark brown, shining. 2nd and 3rd pairs of legs very long and slender, and always in motion. 3rd to 9th somites each with a paired dorsal hump. Anal processes replaced by a pair of longish, down-curved processes. The anterior and posterior portions of the body held erect. A very good ant mimic both in appearance and behaviour.

Half-grown larva—Head large, dark purple brown. Body dark brown, rather shiny. A yellow brown dorsal blotch on the 5th somite and a large white one on the 7th and 8th. 1st pair of legs longer than in normal lepidopterous larvae and stout, 2nd and 3rd pairs very long and slender. 3rd to 8th somites each with a pair of dorsal tubercles, those on the 4th and 5th largest, 4th to 6th somites each with an additional small lateral tubercle. 9th somite expanded sublaterally into a leaf-like process. 10th somite backwards expanded sublaterally so that this portion of the body is roughly triangular and terminates in a pair of down-curved processes, slightly expanded just before the apex, which replace the anal claspers. The ventral surface of the hind part of the body very dark brown and shiny, the dorsal surface humped and marked with pale brown just anterior to the hump. The usual resting position is with the abdominal claspers only gripping the support, the anterior and posterior portions of the body held erect, with the legs folded back under the thorax. In this position it does not look like a lepidopterous larva at all, but rather like an irregularly curved, dead leaf.

Penultimate instar—Shape similar to the earlier instars. Colour dull blackish, a white dorsal and subdorsal line from the 5th to 9th somites, and a shiny black blotch just above the 1st and 2nd pairs of abdominal prolegs, with another, marked behind with white, above the 4th.

Final instar—Very similar to the preceding, the ground colour sprinkled with minute white specks. The lateral blotch above the 1st and 2nd abdominal prolegs still present, but not shiny and edged in front and below with white, that above the 4th absent.

Pupa in a loose cocoon of pale brown silk spun among leaves. Mahogany colour, shiny. Apex of abdomen blunt, cremaster a minute bunch of spines bent at right angles about half way along.

Food-plant—*Ricinus communis* L., *Cassia fistula* L. Gardner gives *Cassia javanica*, *C. glauca* and *C. fistula.*

Described from larvae bred from ova found in Calcutta, one of which spun 26-ii-44 and a male emerged 8-iii-44.

Moore's description is as follows:— 'Larva purplish-black, naked; two dorsal conical protuberances on fifth to ninth segment, subanal segment tumid; two angular processes from anal segment; anal prolegs obsolete; head large; second and third pair of forelegs long; anal segments carried erect. Cocoon silky, ferruginous. Pupa purplish-black.' Hampson writes 'Larva dark red-brown; a pale dorsal line; grey subdorsal streaks on 5th and 6th somites; paired dorsal prominences on 6th to 8th somites; the terminal somite swollen and carried over the back, with two angular processes from the extremity; the anal prolegs absent; 2nd and 3rd pairs of legs long.'

LIMACODIDAE.

Narosa doenia Moore.

Hering, *Seitz Indo-Austr. Bombyces*, x, 677. 1931.

Head pale brown, retractile. 1st somite green, retractile. Body bright apple green, a subdorsal yellow line, curved outwardly so that the ends are rather closer together. Venter transparent, the ventral area separated from the lateral by a cream stripe. Clothed with short bristly pubescence. The larva has the appearance of being covered with a glassy layer, below which small bright yellow-green specks can be detected at certain angles. Shape ovoid, convex, the segmental divisions not well marked.

Cocoon almost spherical, of the usual hard Limacodid type, dark brown with an overlay of paler brown, this overlay absent at the points of contact with the support. Spun in the fold of a leaf of the food-plant. Empty pupa skin brownish yellow.

Food-plant—*Ricinus communis* L.

Described from a full fed larva found in Calcutta 18-xi-43, spun 21-xi-43 and a male emerged 22-iii-44.

The description in Seitz is as follows:—'The larva of the type of the *lohor* larva, but smaller and light green, lives on Erythrina. Cocoon globular.'

NOCTUIDAE.

Autoba (*Eublemma*) *olivacea* Wlk.

Gardner, *Indian Forest Records*, vi, 273. 1941.

Head brown. Body purple brown. 1st somite with a black dorsal plate, divided by a white line down the centre and speckled with whitish. 2nd and 3rd somites with an elongate subdorsal and a double sublateral raised greenish-white spot, another smaller spot at the base of the leg. 4th to 11th somites with a double dorsal, a subdorsal, a double lateral and a sublateral raised greenish-white spot, the subdorsal spot placed posterior to the dorsal. 12th somite with a transverse series of four similar spots. Venter with traces of transverse series of similar, but smaller, spots, the spot on the ventro-lateral area and the one next to it larger. All these raised spots giving rise to single, medium length, whitish hairs. Anal somite speckled with greenish white. Legs black. 1st and 2nd pairs of prolegs obsolete. Lives in a spun together leaf or under a roof made of the felted hairs of the food-plant.

Pupa in cocoon spun in the fold of a leaf of the food-plant and mixed with felt thereof. Dark purple brown, slightly darker on the dorsum. The wing cases and thorax tinged with olive. Prothorax with a slight frontal keel. Cremaster broad and flat, ending in a point on each side.

Food-plant—Brinjal.

Described from a full fed larva found in Calcutta 4-x-44, spun 13-x-44 and a female emerged 21-x-44.

GEOMETRIDAE.

Pingasa (*Pseudoterpna*) *ruginaria* Guen.

Prout, *Seitz Indo-Austr. Geometridae*, xii, 49. 1932.

Head pale green with a pale stripe behind, very slightly bifid. Ground colour pale green, a dark dorsal line. The thoracic somites with a darker green lateral stripe. 4th to 9th somites with a dorsal series of dark green V-shaped marks edged indistinctly with whitish, the apices directed backwards. A subdorsal white line from the 10th somite backwards. A sublateral yellowish white line. Venter slightly darker green, with a median white line and a series of V-shaped white marks with the apices directed forwards. Legs whitish, a stripe from the base of the third pair joining the sublateral stripe. Later in the instar the dorsal area of the 1st to 4th somites, a transverse band posteriorly on the 5th to 9th, and the dorsal area of the 10th and 11th somites suffused with purplish. The venter with the white Vs and the contained area similarly suffused. This is not an immediate, prepupational change.

Pupa in a spun together leaf. Ground colour pale pinkish buff minutely speckled with greenish black, the speckling rather thicker along the dorsal, subdorsal and sublateral areas and forming indistinct stripes. Wing cases heavily speckled along the costal and inner margin, and less heavily along the veins. Thoracic spiracles placed in a deep pit in a black spot and with a transverse black band joining them. Head marked with black frontally and with a greenish black stripe along the proboscis sheath. Cremaster a blunt triangle, hollowed out beneath and ending in a cluster of hooked bristles.

Food-plant—Litchi (*Nephelium litchi*).

Described from a full fed larva found in Calcutta 19-iii-44, pupated 26-iii-44 and a female emerged 7-iv-44.

Seitz gives no actual description, but mentions the following:—'Piepers has described the mimicry of the larva, which simulates a small snake, the head and legs being held a little separate to represent the open mouth, a pale lateral stripe on the body widening anteriorly.' I have not seen the original description but I feel that mimicry of a snake, however small, by an inch and a half long larva is somewhat fanciful.

PYRALIDAE.

Myelois pectinicornella Hamps.

Head dark chestnut. Body very pale pink. 1st somite with a narrow black dorsal plate divided down the centre. A subdorsal, lateral and sublateral series of minute black specks, each giving rise to a short colourless hair. 12th somite with a larger dorsal, semi-circular, black spot in addition to the others, which are larger than on the other somites. Anal flap and claspers black. Legs black. Abdominal prolegs very pale pink. Spiracles blackish.

Pupa in a shuttle shaped cocoon of tough white silk, covered with frass and debris. Pale chestnut brown dorsally, below brownish yellow. Thorax with a serrate dorsal ridge, 1st to 7th abdominal somites each with a double dorsal conical spine, both ridge and spines very dark brown. Cremaster two stout downcurved spines. Spiracles black.

Food-plant—*Pongamia glabra*. Several larvae live in a pod, feeding on the ripe seeds, and the cocoon is spun therein.

Described from a full fed larva found in Calcutta 23-i-45, spun 24-i-45 and a female emerged 8-ii-45.

(*To be continued*)

CAVE FAUNA

BY

E. A. GLENNIE

This short note on cave fauna will be restricted to a consideration of those forms of animal life capable of living generation after generation in parts of caves remote from any entrance and in total darkness. These will be referred to as 'troglophils'. In contrast with these we have those animals which live outside caves on the surface or below ground as far as the lowest penetration of roots of trees, or in the holes made by worms, foxes, etc.

There is an intermediate fauna of very great interest. This is the fauna which uses the thresholds or antechambers of caves. Some of them go in to hibernate—flies, moths, reptiles, etc. ; others, such as swiftlets and bats, use the cave as a habitation going outside for their food. Associated with this last class is a great concourse of creatures living as parasites, or on the droppings or on the moulds growing thereon. These may be mites, myriapods, insects, molluscs, isopods, etc. ; and then there are the animals that prey on them,—beetles and their larvae, spiders, etc.

In one such cave in the Simla Hills which housed a large colony of bats, there was such a multitude of large snails that they could not be avoided. Every footstep crushed five or six of them.

Some members of this threshold community are potential troglophils, but usually the effect of the occupation of part of a cave by large numbers of bats or swiftlets is to drive away all troglophils not ecologically adapted to this environment, to the unpolluted parts of the cave. Thus in Swiftlet Pot in the Chakrata Tahsil, U.P. the main part of the cave, where the swiftlets nest, contains no troglophils. These are found in this cave only in a very small deeper chamber difficult to reach. Here the true cave collembola and spiders are found in surroundings unaffected by the birds.

The study of this threshold fauna is important. It can be pursued not only in natural limestone caves, but also in any large cavities in rocks, in artificial caves such as at Elephanta, in the entrances to ancient mines and in the deeper chambers and passages of old forts. Naturalists who have not got the opportunity or the inclination to penetrate deeply into extensive caves will find this study well worthwhile.

2. Troglophils may derive from ancestors which entered the cave at different periods of its formation. Hence since deep caves are almost invariably due to the solution of limestone by water, a brief account of the origin of limestone caverns is required here.

Limestone caves are usually considered to have been formed by solution or erosion due to surface water trickling through joints and fissures. If there is an actual stream running through the cave, or near by, it is pointed out as the stream which made the cave. This is seldom the case. As J. Harlen Bretz says 'Most caves are out of adjustment with the topography of their region, and therefore are older than the present cycle of erosion.' This is emphatically the case with all caves in India seen by the writer.

According to the modern theory of cave formation there are three stages in their development. These are:

First or Phreatic Stage.

This is due to solution by water *under pressure,* that is, below the local water table. Often it will have commenced beneath a peneplain towards the close of a previous cycle of erosion. Some clay-filling may occur at this stage.

Population of the water-filled solution cavities is only possible for minute animals since these must filter through the very narrow cracks in the overlying rocks or soil.

Many minute crustaceans are less than a millimetre in greatest dimension and their entry will usually be quite possible. At the same time minute fragments of vegetable or animal matter will percolate through and provide food. In this connection it is interesting to enquire whether the water table below the Indo-Gangetic alluvium contains a subterranean population. If this is so, it may be brought to the surface in areas of tube well development. Only careful examination over a long period would disclose the existence of these tiny transparent animals.

Second stage: Removal of Phreatic Water.

Following uplift of the land introducing the present cycle of erosion, the phreatic system of cavities begins to drain out, at first in the upper parts only; later as uplift or external erosion proceeds, perhaps the whole will be drained.

In the parts of the system now drained, isolated pools containing Stage 1 fauna may remain. In the air-filled cavities stalactites and stalagmites and other calcite deposits will begin to form.

These cavities now offer a home for land troglophils. So long as there is no obvious opening, their colonization will depend on the extent to which narrow joints in the rock contain a subterranean population. Dr. Racovitza of the Speleological Institute, Cluj, has suggested that the innumerable narrow joint cracks in limestone hold a teaming population, and that the population of the larger cavities is only a small fraction of the whole.[1] This is difficult to prove or refute. There are great numbers of large subterranean cavities isolated from the surface. These may be detected by geophysical methods or penetrated by chance by mine-shafts. If on first penetration of such a cavity, immediate examination for fauna (and flora i.e. fungi) could be made, the results whether negative or positive would be useful.

It is a fact that certain cave beetles show a marked development of sensory hairs on their elytra which seem designed to protect them from becoming jammed during wanderings in narrow cracks, and others, e.g. opilionids, even in the remotest parts of caves are only to be found under stones or in crevices.

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[1] Biospeologica II, 1907 p. 386, by E. G. Racovitza (archives de zoologie expérimentale, Paris Libraviie H, Le Soudier).

The early stages of some cave beetles have never been found in spite of intense search, though the adults are common. The assumption is that this part of their lives is spent in crevices.

The absence of local races or subspecies in separate caves in the same area would be an argument in favour of migration along joint cracks.

It must be remembered too that, to a creature whose height is less than a millimetre, a fissure two or three millimetres wide is a roomy passage. Hence without any obvious surface openings a subterranean cavity may become populated by land troglophils during the Second Stage.

Third or Vadose Stage.

In this stage the water in the cavities is not confined under pressure but has a free surface.

As soon as the joints or fissures are sufficiently open to admit rain water freely to the air-filled cavities below, the third stage commences. If at any time a surface stream, eroding its banks or deepening its bed discovers a cave and pours into it, this stage proceeds at an accelerated pace.

The rainwater or the stream carrying debris and silt commences secondary erosion and solution, or clears away to lower parts the clay-fill of the first stage where this existed.

The intruding streams are misfits in the caves and alter them

Surface streams and flood water will wash in water- and land-animals; most of these will be unsuited to cave life but will provide food for the troglophils. Others will add to the cave population.

Some parts of the caves may be untouched by vadose streams; other parts may be affected for a time and then be cut off by the deeper erosion of the main stream channels. Finally the surface drainage may cut down so far below the cave that there is no further flooding in of water-forms, but the way is clear for the entry of land animals.

This brief description of the origin of limestone caves is very incomplete. Those who wish to read more about it should refer to the works of Professors William Morris Davis[1] and J. Harlen Bretz.[2]

3. I have tried to give a picture of the continuous invasion of caves from the first stage of their formation to the present time. The earlier stages may have occurred at a remote period long before the emergence of Man, and at that time the cave may have been in very different surroundings and climate.

So little collection has been done in Indian caves that there is little evidence, so far, to show to what extent animals from the earlier stages may have lingered on in caves after vanishing from the surface.

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[1] Origin of limestone caverns by W. M. Davis *Bulletin* of the Geological Society of America, Vol. XLI (1930), pp. 475-628.

[2] Vadose and phreatic features of limestone caverns by J. Harlen Bretz The *Journal of Geology* (University of Chicago Press) Vol. L, No. 6, Part II (1942), pp. 675-811.

Troglophils are usually representatives of groups not much studied, and the discovery of a new genus or species in a cave does not necessarily mean that it is not to be found on the surface.

Thus, for instance, the recent discovery of a palpigrade (*Arachnida*) in an Indian cave has no special significance, although it is believed that this is the first find of this family in India. It has a world-wide distribution and may well have surface forms in India which have not yet been recorded.

The large cave *Campodea* which the writer found in two widely separated caves in the Simla Hills is probably a survival in caves from a time when *Campodea* of this size were widely distributed as surface forms. This striking creature is much larger than the *Campodea* of the Mamouth Caves of America, which are themselves larger than any known surface forms.

A *Collembola* found in certain caves in the Dehra Dun District, U.P., is described by Dr. R. S. Bagnall as an *Onychiurus* of exceptional interest since it combines the features of two distinct groups. So this also seems to be a sort of living fossil.

4. If the long survival in caves of certain troglophils is established, the question arises—To what extent are the present survivors similar to their surface representatives at the time of their first migration into caves? or in other words—What changes have occurred during their sojourn in caves?

Before attempting to answer these questions, it is first necessary to enquire what sorts of creatures are capable of colonising the deeper parts of caves, i.e. What are the potential troglophils?

These are:

I. LAND ANIMALS.

A. Non-predators

Those dependent on green vegetation, or dependent on specific food not obtainable in caves are excluded. The food of non-predatory troglophils is decaying vegetable or animal debris, moulds and other fungi.

Large animals cannot survive for want of food sufficient to support them for long.

Hence non-predatory troglophils are derived mainly from those small creatures living on the surface in humid micro-caverns i.e. in fox holes, underground ant nests, etc., in cracks of rocks or under stones, under bark, under dead wood or leaves, or deep in wet moss, etc.

The importance of humidity must be stressed. Troglophils are characterised by an intolerance of a dry atmosphere.

Migration into caves is not deliberate but is the result of response to an urge to seek any dark damp place and in some cases narrow and confined places.

The chief non-predatory troglophils are:

(i) Primitive wingless insects of the order *Apterogota-Collembola* (Spring-tails).

(ii) Certain families of *Diptera* e.g. *Mycetophyllidae*.

(iii) *Arachnida*—Mites.

(iv) *Myriapoda—Diplopoda* (millipedes).
(v) Worms.
(vi) Molluscs (snails).

Collembola usually form the chief non-predatory part of a cave community, and provide sustenance for many of the predators.

B. Predators

These are in general those which, on the surface, live in the same situation as the non-predators which are potential troglophils, as in A above, in order to prey on them.

Also the larger true spiders and others which begin as threshold colonists and spread into the deeper parts.

Thus we have:

(1) Beetles.
    Staphylinidae.
    Cryptophagidae.
    Pselaphidae.
    Certain groups of *Carabidae*, etc.
(2) Orthoptera.
    Crickets.
(3) Apterogota.
    Campodea.
(4) Arachnida.
    True spiders.
    Opilionids.
    Mites.

II. WATER ANIMALS.

As in the case of land animals, those water animals which are preadapted to some extent to cave life are potential troglophils. These will be those which are nocturnal in habit, or which live in holes, under stones or in mud.

Water troglophils have a tendency to shun the light. Unlike many land troglophils which, if the humidity is sufficient, may stray outside, fully adapted water-troglophils find light an effective barrier, and will remain in the dark parts of the cave, even though there is a free and easy passage out into the light.

Water animals may be:

1. Fish.
2. Crustaceans.
3. Worms.

The only cave in India containing permanent water which I have entered was in the Kaimur Hills of Bihar. There I found a colony of catfish in an isolated pool beyond the reach of any possible flood water about 200 yards from the entrance of the cave.

5. It is evident from the preceding section that most potential troglophils are already adapted wholly or in part to cave life.

There is a marked uniformity of environment in a cave; in consequence accelerated evolution due to climatic vicissitudes, etc. is absent. The population, however, may be small and isolated, and in such a case chance variations even though not adaptive may be fixed. In this way different sub-species or closely related species may come into existence after a relatively short time. If the changes are adaptive, selection will assist the evolution.

6. Adaptations are those changes advantageous to life in caves.

A 'living' cave is one where stalactites and stalagmites are in active formation. Every stalactite has a drop of water hanging on its end, occasionally falling and quickly replaced by a new drop. A film of water covers walls and floor forming occasional pools. The percentage humidity is over 90. The air is clean and fresh, but without noticeable draughts, and the temperature does not vary more than a degree centigrade throughout the year.

A cave in this condition is ideal for troglophils.

Though the air is apparently still it circulates freely and remains good. In places even a mile or more from the entrance there may be a strong draught, sufficient to blow out a candle, but troglophils avoid such places because of the increased evaporation and seek out the parts where the conditions are more equable. They also tend to avoid the main streamways.

The special conditions are:

i. complete darkness.
ii. uniform temperature.
iii. uniformly high humidity.

Proved adaptations are increase in size of sensory organs, e.g.,

i. Increase in length of special setae.
ii. ,, ,, ,, ,, antennae, palps, etc.
iii. ,, ,, ,, ,, legs where they are used for tactile purposes.

Other changes are:

i. loss of colour and pattern.
ii. degeneration, reduction or elimination of eyes.
iii. marked intolerance of reduced humidity.

These are usually considered to be adaptations, but their only advantage is in economy of metabolism. This may be important where food is scanty. Evidence in favour of this provided by those creatures which live on the droppings in bat-infested caves. Here darkness may be complete, but the food is unlimited. Change of colour, degeneration of eyes, etc., does not take place[1].

The loss of colour may be very marked. The legs of some spiders are as transparent as glass and so are the long cerci of the large cave *Campodea*.

Fish speedily become white when introduced into a cave but quickly regain colour when returned to the open.

If the functionless eyes of some cave spiders are the result of disuse, this is an acquired characteristic and should not be heritable. Possibly the newly hatched spiders do have eyes which can be used, and would continue to use them if brought up in the light under suitable conditions. This would be an interesting line of enquiry.

The reduction or complete elimination of eyes, however, is a fundamental change. Here we may have the result of the perpetuation in an isolated community of a chance variation which would be disadvantageous on the surface, but in a cave may be an advantage because economical, and so it would be favoured by selection.

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[1] *Encyclopedia entomologique,* VII, Faune cavernicole de la France, 1926, p. 63 by Dr. R. Jeannel.

7. A cave is a natural laboratory where some of the variable factors in the outer world are under control.

Some creatures live on in them though they are no longer to be found outside. Indeed it seems to be a significant fact that at the limits of the region of dispersion of a group of animals the living forms are often only to be found in caves.

Careful collection and recording will in course of time shed much light on the course of evolution and on the places of origin of genera and their channels of distribution.

Ancient artificial caves, whether rock dwellings, temples or ancient mines, if of sufficient extent and humidity, and of known date may provide information of great value if their troglophil population is statistically examined in comparison with the same forms on the surface in the locality.

THE ORNITHOLOGICAL DIARY OF A VOYAGE OF S. S. *SAMLUZON*

ST. JOHN N.B. TO KARACHI, INDIA

4 June, 1945 to 7 July, 1945

BY

MAJOR W. W. A. PHILLIPS, F.L.S., M.B.O.U.

Introduction

The observations contained in the following diary were made during a voyage of approximately five weeks duration, across the North Atlantic from St. John N.B. to Cape St. Vincent, then through the Mediterranean and Red Seas and up that part of the Indian Ocean known as the Arabian Sea from Aden to Karachi.

With the exception that we could not change her course, the *Samluzon* our ship, was practically our own. By the kindness of her Master, Captain Howe, and his Officers, we were permitted to go where we wished, at any time of the day or night, consequently we were able to spend many interesting hours on the bridge, in the bows or gazing over the stern, watching the many oceanic birds that crossed our path or crowded into our wake.

Conditions for the observance of bird-life were as good as they could be from ship-board, but even so, it must be remembered when reading the following pages, that an element of uncertainty must always be present in identifications made by sight alone. There was no possibility of securing specimens to confirm identifications and, in some cases, especially with the petrels and to a lesser extent with the shearwaters, accurate identification 'in the field' or in this case 'in the ocean' is by no means easy. With the aid of a pair of 7 × 50 U. S. Navy MKI binoculars, or (when they were not available) a smaller pair of 6 × 24 Zeiss Sports field glasses, and with the assistance of the reference books listed at the end of this paper (some of which were available during the voyage), I have endeavoured to be as accurate as the circumstances permitted.

S. S. *Samluzon* is a Liberty ship of some 10,000 tons burthen. Her speed was normally a steady average 10 knots an hour, except while plunging into heavy, head-on seas, when, owing to being deeply laden, often several knots an hour were lost.

All times recorded are Sun times, according to the approximate position of the ship—that is to say, they are the 'apparent' time of the ship. Clocks were advanced at 17.00 hours, each evening, while we were steaming eastwards. The ship's position was fixed at mid-day each day, in accordance with the usual maritime procedure.

Owing to the voyage having taken place during the months of June and July when the vast majority of Northern Hemisphere birds are normally engaged in breeding and so are closely restricted, in range, to the vicinity of their nesting grounds, comparatively few land-birds were encountered and many species of sea-birds, so commonly to be seen during voyages at other seasons of the year, were conspicuous by their absence. No migrations were in progress, so only a few wandering land-birds were crossing the seas and, as the majority of gulls were in their Northern home waters, such harbours as Port Said and Suez, where during the winter months large numbers of Black-headed and other species congregate and do such useful work in scavenging the ship's refuse, were comparatively empty of bird-life, except for a few immature or non-breeding birds and those resident species that presumably breed somewhere in the vicinity.

These factors account for fewer birds having been observed, during this voyage, than would normally have been the case on a long sea voyage during any other season of the year. On the other hand, such observations that I was able to make have, I consider, a special value in that they were made at this particular time of the year when migration is in abeyance and most birds are normally restricted to their nesting areas. Except for a few vagrant land-birds (all of which would be either immature or non-breeding birds) and some of the oceanic forms, such as Wilson's Petrel (*Oceanites oceanicus*), which are reputed to breed in the Southern Hemisphere during the Northern Winter period, the great majority of the birds observed were, I think we are safe in presuming, within easy range of their breeding haunts. This factor adds greatly to the interest of this diary and presents a reasonable theory for the noticeable restriction of certain species observed, to certain very definite and comparatively small areas, in which they were present in large numbers while being totally absent from neighbouring areas.

DIARY

June 4, *Monday.* Saint John Harbour, N.B. Lat. 45°14 N. Long. 66°30 W.

Sailed at 18.30 hours. Wind cold, moderate from N. E.; snow reported on the hills, about 20 miles north, a few mornings previously.

Steaming down the harbour, past Partridge Island, the ship was accompanied by many Herring Gulls, presumably of the American race (*Larus agentatus smithsonianus*). On the wing, these gulls are very similar to the European race. The great majority of them were in full plumage, but here and there was an immature individual. No other species of gull was observed. The Herring Gulls were very numerous and acted as harbour scavengers, in the manner usual to gulls of the present day.

Except for the introduced European House Sparrows (*Passer domesticus*) and the semi-wild domestic pigeons, which were feeding on the quays and docks, the only birds seen in the harbour area were the Double-crested Cormorant (*Phalacrocorax auritus auritus*), and a single Black Crow (*Corvus brachyrhynchus*) which flew overhead, making towards the Northwest.

The Double-crested Cormorants were very numerous. In the morning and evening, fishing singly, they were to be seen on the harbour waters; later, flying in small flocks close above the water and again high over our mast tops. At low-water they congregated in groups, on the rocks and reefs exposed by the tide, generally sharing their retreats with many Herring Gulls.

June 5, *Tuesday.* N. Atlantic Lat. 43°06 N. Long. 66°12 W.

Sea moderate; breeze light, from N.E.; weather clear.

A few Herring Gulls followed the ship most of the day or were seen flying, lazily, some distance away. No other birds were observed.

June 6, *Wednesday.* N. Atlantic. Lat. 42°01 N. Long 61°42 W.

Wind from N.E., strong to variable; sea rough with a heavy swell.

At 10.00 *hours* entered the waters of the Gulf Stream.

Many petrels appeared, mostly flying close above the sea, in no set direction; others followed our ship, flying more or less in the lee of our stern or to and fro across our wake; sometimes there were 20 or 30 wheeling around. All those that could be seen distinctly, appeared to be Wilson's Petrels (*Oceanites oceanicus*) and Leach's Petrels (*Oceanodroma leucorhoa leucorhoa*), Wilson's being much the more numerous. It is not easy to distinguish the various species of petrels in flight; Wilson's appears slightly smaller and darker than Leach's and the feet project well beyond the tip of the tail; they fly close over the water wheeling, twenty feet or more into the air. Several shearwaters, a little distance away from the ship, were wheeling close over the waves, in a similar manner to the petrels, but sometimes one would rise fifty feet or more into the air, and then sweep back to wave level. One, nearer than usual and seen clearly, had a black cap to the head with a light neck. Could it have been the rare Black-capped Petrel (*Pterodroma hasitata*)?

Several of the large shearwaters appeared to be the Greater Shearwater (*Puffinus gravis*) and one or two smaller and darker birds the Sooty Shearwater (*Puffinus griseus*), but visibility was not good and it was difficult to identify them. Our Captain calls petrels 'icebirds' and states that they are generally more numerous near icebergs and ice-fields. Many petrels were finding food in our wake, in the water churned up by the screw.

June 7, *Thursday.* N. Atlantic. Lat. 42°02 N. Long. 56°00 W.

In Gulf Stream. Wind moderate from S.W.; sea calmer but swell still heavy.

A few petrels and shearwaters seen during the day, but not nearly so plentiful as yesterday. Most petrels were dark sooty black with square tails and projecting feet—presumably Wilson's. Shearwaters were mostly too far away for certain identification but they were all large and were, I think, the Greater Shearwater (*Puffinus gravis*).

June 8, *Friday*. N. Atlantic. Lat. 41°41 N. Long. 50°33 W.

In Gulf Stream. S. W. wind dropped; sea calmer but still a heavy swell.

Morning. Passed several petrels and shearwaters; the petrels all appeared to be Wilson's and the shearwaters to be Greater Shearwaters (*Puffinus gravis*).

15.00 *Hours*.—Four Greater Shearwaters (*Puffinus gravis*), together and one, decidedly greyer, near the bows of the ship. The latter undoubtedly a North Atlantic Greater Shearwater (***Puffinus kuhlii borealis***). It was lighter and greyer than ***Puffinus gravis*** and possibly rather larger.

15.10 *Hours*.—I saw a bird, about a hundred yards from the starboard bow, which I was unable to identify; head, neck and underparts were white and the back was mottled blackish and white; the tail appeared to be short; the flight was rather quick; it looked somewhat like a Tropic Bird, many of which I have seen in the Indian Ocean. Many petrels passed at some distance.

June 9, ***Saturday***. N. Atlantic. Lat. 41°34 N. Long. 41°5 W.

In Gulf Stream. Wind W. to N.W.; sea almost calm but slight swell continues; sunny in morning, with light cloud later.

All day, we saw only three shearwaters, all too far away for accurate determination; they were large and dark and were, most probably, the Greater Shearwater (***Puffinus gravis***).

June 10, *Sunday*. N. Atlantic. Lat. 41°59 N. Long. 39°30 W.

In Gulf Stream. Wind W. to N.W.; sea almost calm but slight Swell continues.

9.15 *Hours*. Five, later increased to eight or nine, shearwaters were flying round our bows, in open order; they were dark brown above, rather dingy white beneath; they were all, I think, the Greater Shearwater (*Puffinus gravis*). Later, two others appeared on the port side; they appeared similar in size but were definitely greyer on the upper parts. These, I take to be, the North Atlantic Great Shearwater (***Puffinus kuhlii borealis***).

11.00 *Hours*. Another eight or nine shearwaters have appeared flying in pairs, in a loose flock, crossing and recrossing close to our bows; they are large and brown and are undoubtedly ***Puffinus gravis***; possibly the same birds we saw about 9.15 hours today.

Three petrels have followed our wake this morning; at 15.00 hours one is still with us. These petrels fly close over the water, back and forth across our wake; they evidently find food in the churned-up water. They all appear to be Wilson's Petrel (*Oceanites oceanicus*) with unforked, square tails and projecting feet.

16.00 *Hours*. Only one petrel was following the ship but at 18.00 hours there were eleven or twelve; they all appeared to be Wilson's Petrels. No shearwaters seen after mid-day.

June 11, *Monday*. N. Atlantic. Lat. 40°29 N. Long. 34°00 W.

Wind E.; light; slight swell.

8.30 *Hours*. Two petrels flying in our wake; several others passed during the morning; they were all Wilson's. A flock of nine or ten shearwaters were flying round our bows at 09.45 hours; they all appeared to be ***Puffinus kuhlii borealis***. Several shoals of dolphins were passed during the morning.

10.15 *Hours*. A small shearwater appeared on the port side. It was blackish above and white below, like the Manx Shearwater (***Puffinus puffinus***), great numbers of which I saw in the Irish Sea in March last. This shearwater, I take to be the Madeiran Little Shearwater (***Puffinus assimlis baroli***) as the Manx would not be so far south at this time of the year. No petrels seen after mid-day. Probably most of them have remained in the warmer waters of the Gulf Stream; we have now almost passed out of the southern edge of this current.

Afternoon.—A few shearwaters flew in large circles around the ship. They seem to enjoy flying back and forth close over our bow, down one side of the ship, across our wake and up the other side, generally keeping at some distance from the ship and wheeling around, first one way and then the other, as they circle. They are, I think, all North Atlantic Great Shearwaters (*Puffinus kuhlii borealis*), with rather mottled, whitish underparts. They did not appear to pick up any food. *Note.*—I have seen hundreds of shearwaters, of many species, at sea but I have yet to see one feeding by day.

June 12, *Tuesday.* N. Atlantic. Lat. 39°56 N. Long. 28°44 W.

Approx: 25 miles N. of Corvo Island, Azores.

Wind moderate from N.E.; swell continues; fine but cloudy.

7.15 *Hours.* Heard shrill cries of terns and, on going out, found two Arctic Terns (*Sterna paradisaea*) flying close above and hovering over our ship, screaming loudly; one settled, for a few seconds, on the top of the flag-pole in our bows. After half an hour they flew off in a northerly direction, flying rapidly close above the waves; presumably they were on migration.

Four or five petrels (Wilson's as far as could be seen) were following in our wake. Four, possibly two pairs, flew off towards the N.E. at about 09.15 hours. Many shearwaters are circling the ship; several passed close under our stern, making identification almost certain; all were *Puffinus kuhlii borealis.*

10.00 *Hours.* A single petrel following our wake; soon after, another, then another, arrived, until four were sailing back and forth across our wash, occasionally settling to pick up minute particles of food. One, slightly larger and browner than the others, was Leach's (*Oceanodroma leucorhoa leucorhoa*), I think; the other three were Wilson's. All petrels seen so far (a very great number) appear to belong to these two species (*Oceanodroma leucorhoa leucorhoa* and *Oceanites oceanicus*, the great majority being Wilson's recognisable by their squarish tails and long legs. It is, however, exceedingly difficult to distinguish these very similarly marked petrels when they are flying to and fro at a little distance from the ship. Some of those seen in our wake, during the last few days, may, very possibly, have been the Madeiran Fork-tailed Petrel (*Oceanodroma castro*).

Afternoon.—About 50 miles from the Azores; N.E. wind freshening; sun shining.

Very few birds; no petrels, but several shearwaters (*Puffinus kuhlii borealis*) sweeping over the waves, the sun glistening on their whitish underparts as they wheel and turn.

18.00 *Hours.* While watching Great Shearwaters (*Puffinus kuhlii borealis*), I saw a smallish dark-coloured bird, which I am unable to identify with certainty; size and flight were very similar to the Manx Shearwater (*Puffinus puffinus*) but, in the evening light, the bird looked unicoloured, dark blackish brown both on the underparts as well as on the upper. No white could be seen; wings were pointed and shaped like a shearwater; build was rather light; obviously it was a shearwater or closely allied species; possibly it was the rare Bulwer's Petrel (*Bulweria bulwerii*) the description of which seems to fit it. Wind now freshening to gale-force; waves are white-capped and are coming inboard over our bows. No petrels in sight but a number of Larger Shearwaters (*Puffinus kuhlii borealis*) are sweeping low over the waves.

June 13, *Wednesday.* N. Atlantic. Lat. 39°27 N. Long. 24°09 W.

Strong wind from N.; sea rough; swell moderate; fine and sunny.

No petrels; all appear to have remained in the warmer waters of Gulf Stream, where food is probably more plentiful. With the exception of an occasional Great Shearwater (*Puffinus kuhlii borealis*) no birds were seen all day.

June 14, *Thursday.* N. Atlantic. Lat. 38°53 N. Long. 20°31 W.

Strong wind from E.N.E.; sea rough with heavy swell; cloudy but fine.

No birds until 09.10 hours when a Turtle Dove (*Streptopelia turtur*) flew round the ship and attempted to settle but the strong wind prevented it from doing so. The nearest land, the Azores, is about 215 miles to the S. W., in which direction the dove eventually disappeared, flying low over the waves and much buffetted by the wind. The Portuguese coast is now about 530 miles N.E.; the wind is strong from E.N.E. so the dove may have been blown from there.

Later, a single Large Shearwater (*Puffinus kuhlii borealis*) crossed our bows and the 3rd Officer reported seeing three petrels, in the trough of a wave, about mid-day.

18.15 *Hours.* Another solitary shearwater (*Puffinus kuhlii borealis*) passed, flying in a S.W. direction.

June 15, *Friday.* N. Atlantic. Lat. 38°66 N. Long. 17°18 W.

N.N.E. wind, which reached gale force during the night, is now moderating; heavy swell; cloudy but fine and clear. Speed reduced to about 7 knots.

No birds seen all day. Chief Officer reported having seen a single shearwater about 17.00 hours.

June 16, *Saturday.* N. Atlantic. Lat. 37°28 N. Long. 13°17 W.

N.N.E. wind moderating; sea and swell considerably less.

No birds seen during the early morning.

09.55 *Hours.* A single shearwater, in the distance, wheeling over the waves, its whitish underparts glistening in the sun. No more birds until 18.15 Hours when a solitary shearwater (*Puffinus kuhlii borealis*) flew round our bows for several minutes and then disappeared south.

18.30 *Hours.* Passed two shearwaters (*Puffinus kuhlii borealis*) and later, several more appeared; one had a flight feather missing; possibly it was in moult.

One small, dark brown and white shearwater, too indistinct for certain determination, was probably a Western Mediterranean Shearwater (*Puffinus puffinus mauritanicus*) as it did not appear dark enough for the typical form. The decrease in oceanic bird-life since leaving the Gulf Stream is very notable.

June 17, *Sunday.* N. Atlantic. Lat. 36°40 N. Long. 8°10 W.

Calm sea; no swell; light breeze E.N.E. to E.S.E.

About 07.00 *Hours,* approximately 12 miles N.W. of Cape St. Vincent, sighted an immature Gannet (*Sula bassana*) in brown plumage gliding and flapping towards us. A few minutes later a Turtle Dove (*Streptopelia turtur*) flew close to the ship and continued N.E. towards the land; it was flying strongly.

About 07.15 *Hours.* A flock of nine small terns passed, flying close over the sea; they were too far away for determination of the species.

Four Wilson's Petrels (*Oceanites oceanicus*) are now accompanying us, flying to and fro across our wake; they left us as we approached close to land.

Between 07.50 *and* 08.30 *Hours.* Drawing close to Cape St. Vincent, Gannets (*Sula bassana*) appeared in small numbers, flying in different directions or swimming on the calm sea; in some of them the fore parts (including neck, head and chest) were white, but in the majority the plumage was chiefly chocolate brown. Many Herring Gulls are also flying round, sitting on the ledges of the cliff or swimming in the water; one or two have followed our wake for some distance; they are the Mediterranean Yellow-Legged Herring Gull (*Larus argentatus cachinnans*). All are fully adult and are, most probably, nesting on the ledges of the Cape; no nests can be distinguished, with certainty, but several Herring Gulls are settled on the ledges and appear to be on their nests. At a little distance, we saw several small flocks (six or seven) and a number of pairs of a small shearwater; they were all flying, close over water, in the opposite direction to the ship's course—i.e. towards the Cape; they did not wheel about looking for food but flew as with a definite purpose; possibly they were returning to their nesting burrows; they are considerably smaller than *Puffinus kuhlii borealis* and are dark brown above with whitish underparts; most probably they are the Western Mediterranean Shearwater (*Puffinus puffinus mauretanicus*).

An hour after passing the Cape (09.00 *Hours*) we commenced to flush a few large flying-fish, from under our bows; all birds have disappeared.

10.00 *Hours.* Five large shearwaters appeared 500 yards off and accompanied the ship for a few minutes; they then settled on the calm sea-surface in a close flock; they appeared to be Mediterranean race of the Great Shearwater (*Puffinus kuhlii kuhlii*). One petrel (Wilson's) flew round the ship.

10.15 *Hours.* Another Turtle Dove (*Streptopelia turtur*) flew close over the ship and continued northward towards a schooner in the near distance. A few minutes later two more Turtle Doves appeared, flew close over the ship and made off northwards, in the same direction as the first. Land is now approximately 20 miles away to the North. The African (Moroccan) Coast is about 40 miles to the south; apparently the Turtle Doves are passing from Africa to Spain; but why should they do so at this time of year?

10.20 *Hours.* A flock of eight or nine petrels are flying and feeding close over the water in the wake of a ship that passed about half an hour ago. All are Wilson's (*Oceanites oceanicus*); eight Herring Gulls (*Larus argentatus cachinnans*) following the wake of a Portuguese motor ship, half a mile to the north; later all flew away N. Two gannets (immature brown plumage) crossed our bows, flying low over the water and disappeared southwards, at 10.30 hours. Another, in almost adult plumage, passed soon afterwards.

11.00 *Hours.* Six petrels in our wake, closer than usual; all have the squarish tail and long legs—characteristics of Wilson's Petrel. I did not know that *Oceanites oceanicus* is so plentiful in these waters and in the N. Atlantic; I have seen hundreds this voyage.

11.20 *Hours.* Two large brown shearwaters crossed close to our bows—undoubtedly the Mediterranean race (*Puffinus kuhlii kuhlii*); several petrels are also with us.

13.15 *Hours.* A gannet (immature brown plumage) flew in towards us and sheared off when quite close. All afternoon, thirty or forty petrels have been in our wake—some flying fairly close—all are Wilson's (*Oceanites oceanicus*) which species has been very much the most common since leaving St. John. In flight, tips of the toes project a quarter to half an inch beyond the squarish tail. In many individuals, the feathers—especially the flight feathers—are much worn. The moult is now on, I think. These petrels feed largely on the refuse thrown over from the ship. Their behaviour is very similar to that of gulls, following in the wake of a ship. As soon as edible refuse is thrown overboard a dozen or more congregate at the spot, some paddling and picking up food, others alighting on the water, still others wheeling round; there is much flapping of wings and scrambling for the food. Some of these petrels follow the ship for many miles, occasionally dropping back a few hundred yards, then flying quickly to catch up again until close to the stern; they always fly to and fro across the wake, searching for food.

16.00 *Hours.* Still thirty or forty petrels in our wake and others flying around—all Wilson's. Passed one gannet (immature, brown) and a small number of Mediterranean Shearwaters (*Puffinus kuhlii kuhlii*), generally in pairs. A large shoal of blackfish passed at 16.10 hours and several dolphins and porpoises have also been seen.

16.15 *Hours.* A Common Swift (*Apus apus*) has appeared, flying from S. to N.; it is finding considerable difficulty in making headway against the stiff breeze that has sprung up during the last hour. It flew high above the masts, then down close to the waves in the lee of the ship. I had this swift and two Wilson's Petrels in the field of view of my field glasses, at the same time. The African coast is now about sixty miles to the south; the Spanish coast forty miles to north; the swift is apparently crossing from Africa to Europe. During the evening a number of shearwaters and petrels were round the ship but not so many petrels were in our wake as earlier in the day. The number of petrels with us is now declining gradually as the evening closes in; at 19.30 hours only one was left; at 19.45 hours there were none and no birds of any description were to be seen from the ship.

June 18, *Monday.* Western Mediterranean. Lat. 35·42 N. Long. 2·55 W.

Sea calm; no wind; sky overcast and rain falling; cleared 10.00 hours.

07.30 *Hours.* Fifteen to twenty petrels, all Wilson's, are now in our wake; by 09.00 hours the numbers had increased to approximately twenty to twenty-five; all are of one species. No other birds seen.

10.00 *Hours.* A single shearwater (*Puffinus kuhlii kuhlii*) passed. Many petrels are still in our wake.

11.15 *Hours.* A small lark-like bird was glimpsed flying along our starboard side; it was seen only for a few minutes before it disappeared. It appeared to be a Common Skylark but this identification is uncertain. We are now about fifteen miles north of the Moroccan Coast. Many Wilson's Petrels are still with us.

14.30 *Hours.* When we were forty to fifty miles from the Moroccan Coast, a large gull came from the south, circled several times and flew off towards the S.E., it appeared to be Herring Gull; later, it reappeared accompanied by two others; one settled on the water and the others dropped astern—they did not come close enough to us for certain identification but they appeared to be Herring Gulls.

15.00 *to* 15.30 *Hours.* Passed several schools of dolphins and one pair and a single Green Turtle; the pair were mating on the surface.

15.30 *Hours.* There are still about twelve Wilson's Petrels in our wake.

15.45 *Hours.* A small brownish bird flew on to the forward hatch and remained there; on examination with field-glasses, it proved to be bunting—very like, if not identical with the Corn Bunting (*Emberiza calandra*). On closer approach it disappeared over the side and was not seen again.

16.15 *Hours.* Another large gull appeared and between 17.30 and 20.00 *Hours* there was always at least one and sometimes up to five following in our wake, with the petrels. All are typical Yellow-legged Herring Gulls (*Larus argentatus cachinnans*) in full plumage; yellow feet and yellow bills, with red spot, are very distinctive. At dusk (about 20.00 *Hours*) there are still a few Wilson's Petrels and one or two Herring Gulls in our wake; our position is approximately seven miles from land and thirty miles W. of Oran.

June 19, *Tuesday.* Western Mediterranean. Lat. 36°47 N. Long. 2°27 E.

Seven to ten miles from Algerian Coast. Sea calm; wind very light and variable; sunny.

05.30 *Hours.* Many Herring Gulls are still accompanying the ship, circling round, following in our wake and settling on the sea alongside.

05.45 *Hours.* Three Mediterranean Shearwaters (*Puffinus kuhlii kuhlii*) passed flying close above the water; no petrels are with us.

About 07.30 *Hours.* One or two petrels have appeared in our wake; by 09.15 *Hours* the number had increased to twelve. Herring Gulls are very numerous, circling the ship.

09.30 *Hours.* A Mediterranean Greater Shearwater crossed our wake flying north; fifteen Herring Gulls and twelve Wilson's Petrels are in our wake; all the Herring Gulls are in mature plumage.

14.00 *Hours.* Passing within two miles of Cape Caxine, immediately north of Algiers, a small number of Mediterranean Shearwaters were in sight, several of them between the ship and the shore. All Herring Gulls and petrels have now left us. We started to pick up the petrels again as soon as we were nine or ten miles from land.

15.45 *Hours.* Three petrels are now in our wake, occasionally settling on the smooth water to feed. Considerable numbers of Mediterranean Shearwaters were in sight while we were passing Algiers, flying close to the ship or settling on the water, but fewer are to be seen now we have left the inshore waters.

16.00 *Hours.* No shearwaters or Herring Gulls are in sight; only three petrels flying in our wake.

16.10 *Hours.* Eight shearwaters, in a small flock, settled on the water fairly close to the ship.

17.45 *Hours.* Petrels have disappeared but five Herring Gulls are in our wake; four are in mature plumage but one is a juvenile.

18.15 *Hours.* A single petrel, following in our wake, had left us by 18.30 hours.

18.45 *Hours.* Passed an unusual dolphin; it seemed to be about twelve to fifteen feet in length with a blunt head (like a Black Fish) and small dorsal fin; colour irregularly skewbald, black-brown and whitish all over; owing to its light colour, it could be seen swimming, solitarily, just below the surface, for some considerable distance.

19.00 *Hours.* Several Herring Gulls circling the ship.

No other birds to be seen.

June 20, *Wednesday.* Western Mediterranean. Lat. 37°10 N. Long. 7°55 E.

Sea calm with slight swell; light, variable breeze.

06.00 *Hours.* Many Herring Gulls circling the ship, searching our wake and settling alongside. No other birds.

08.45 *Hours.* Passing near Cape de Fer, several Mediterranean Shearwaters (*Puffinus kuhlii kuhlii*) are flying close over the water. Forty to fifty Herring Gulls (*Larus argentatus cachinnans*) came out and circled the ship; all in adult plumage. Does this gull nest on Cape de Fer? Still no petrels.

09.45 *Hours.* A small shearwater crossed our wake; it was considerably smaller than *Puffinus kuhlii kuhlii*; brown above, whitish below; it flew straight, a few feet above water, with rapid wing beats; it is the first of this species that we have seen in the Mediterranean proper; I believe that it is a Small Mediterranean Shearwater (*Puffinus puffinus yelkouan*) but it was too indistinct for accurate identification. Several Large Shearwaters (*Puffinus kuhlii kuhlii*) are flying about. I notice that, while gulls and petrels feed in the wake of the ship, shearwaters never do.

10.00 *Hours.* Just before A. A. gun practice, a small number of shearwaters (*Puffinus kuhlii kuhlii*) and fifty to sixty Herring Gulls were near the ship. All disappeared as soon as the guns opened up.

10.20 *Hours.* Herring Gulls have begun to reappear and with them several Slender-billed Gulls (*Larus genei*); the first we have seen this voyage. This gull is smaller than the Herring Gull; pure white with a light-grey mantle and the primaries tipped black and white; bill is dark red, more red in some than in others; feet and legs are dark red; several are wheeling round the ship with the Herring Gulls.

10.45 *Hours.* A solitary petrel crossed our wake; the ship is now about ten miles from African coast. Herring Gulls and Slender-billed Gulls are circling us in about equal numbers. No shearwaters are to be seen.

14.15 *Hours.* Gulls are now all Herring Gulls; we appear to have left behind us the territory of the Slender-billed Gull. Did they come from a nesting colony, on the coast near here? We are still only twenty miles off shore. Several Large Shearwaters (*Puffinus kuhlii kuhlii*) are always in sight; seven crossed our bows in a small flock, wheeling and flapping lazily.

14.30 *Hours.* Another Small Shearwater (*Puffinus puffinus yelkouan*) crossed our bows flying S.W.; it is darker brown above than in *Puffinus kuhlii kuhlii*, with a greyish shade to the neck and mantle but without the whitish rump and blackish tips to the tail feathers; white or whitish beneath; it flies much straighter and more rapidly than *Puffinus kuhlii kuhlii*, without any wheeling and slow flaps.

14.50 *Hours.* A Common Swallow (*Hirundo rustica*) flew the length of the ship, at mast height, and then on towards the African coast, about twenty miles away; a male in full plumage. It is curious that a swallow should be going south in the middle of June! Presumably it is a non-breeding wanderer.

15.45 *Hours.* A Slender-billed Gull appeared, with several Herring Gulls, and accompanied the ship; the gulls fly about half a mile ahead, settle on the water, wait for the ship to pass them, drop a mile or two astern and then fly up and overtake the ship again, repeating this procedure for several hours. If refuse is thrown over, all congregate to feed in the wake. Many shearwaters (*Puffinus kuhlii kuhlii*) but no petrels are in sight.

16.10 *Hours.* A Herring Gull, in immature plumage, joined the others, all in full plumage, accompanying the ship.

16.30 *Hours.* The coast is now approximately 7 miles due south; we passed another small shearwater (*Puffinus puffinus yelkouan*) wheeling rapidly over the water; it looked very black and white in the afternoon light.

18.00 *Hours.* Two petrels in our wake, together with many Herring Gulls; a few shearwaters (*Puffinus kuhlii kuhlii*) are also in sight.

18.30 *Hours.* Passing the Fratelli Rocks, three miles to southward, a single petrel was flying in our wake; it appeared to be Wilson's (*Oceanites oceanicus*); many Herring Gulls and a few shearwaters (*Puffinus kuhlii kuhlii*) are still to be seen.

June 21, Thursday. Western Mediterranean. Lat. 36°52 N. Long. 13°04 E.

Sea calmer; swell slight; wind light from E.S.E. to S.E.; bright and sunny.

06.30 *to* 07.30 *Hours.* Passing close to Pantellaria Island, two Herring Gulls came out and accompanied the ship, for about half an hour.

08.30 *Hours.* A solitary petrel in our wake; too far away for determination; no gulls or shearwaters in sight.

09.05 *Hours.* A Turtle Dove settled on our fore-hatch; it appeared, after close examination through glasses, to be a Common Turtle Dove (*Streptopelia turtur turtur*); it remained on board for several hours before disappearing. Later several petrels appeared in our wake.

12.45 *Hours.* Six petrels, all darker and more definitely sooty-black and with shorter legs than the familiar Wilson's Petrel (*Oceanites oceanicus*) have appeared in our wake; their flight and behaviour is very similar to Wilson's; tail squarish but slightly forked. I think that they must be the Storm Petrel (*Hydrobates pelagicus*)—a resident in this part of the Mediterranean.

Sicily is now looming up about thirty miles to northward.

14.15 *Hours.* All the petrels have disappeared; only one Herring Gull is with us. Petrels reappeared in our wake at about 14.30 hours; at about 16.40 hours there were six of them following us. Passed another Small Shearwater (*Puffinus puffinus yelkouan*) flying towards Gozo Island.

18.00 *Hours.* Passing through the Malta Channel, six Storm Petrels (*Hydrobates pelagicus*) still in our wake and one Large Shearwater (*Puffinus kuhlii kuhlii*): No gulls.

19.00 *Hours.* Near Malta, several Large Shearwaters (*Puffinus kuhlii kuhlii*) and two petrels were in our wake. Two large swordfish leaped several feet out of water.

19.30 *Hours.* Another small shearwater (*Puffinus puffinus yelkouan*) crossed our path flying towards Malta; also several *Puffinus kuhlii kuhlii* and Storm Petrels (*Hydrobates pelagicus*) were flying round us and in our wake until dusk.

June 22, Friday. Eastern Mediterranean. Lat. 33°47 N. Long. 18°11 E.

Sea very calm with slight ripples but no swell; light breeze from N. E.; sunny.

No signs of any bird-life until 10.10 hours when a single Storm Petrel (*Hydrobates pelagicus*) was seen.

10.30 *Hours.* Two petrels in our wake but they soon disappeared. No further bird-life observed until the evening.

17.30 *Hours.* A medium-sized warbler came aboard to rest; could not obtain a satisfactory view of it owing to the difficult light and to its constant movement. It appeared to be a dark olive-brown above and a light yellowish-grey on the underparts. It was, I think, a member of the genus *Hypolais*—possibly *H. pallida*, the Olivaceous Warbler. It was very restless and difficult to approach; eventually it retired to roost under the cross-trees of the main mast. The nearest land, Tripolitania, is now about two hundred miles to the S.E.

June 23, Saturday. Eastern Mediterranean. Lat. 32°50 N. Long. 22°47 E.

Sea calm; light breeze from N. W.; bright and sunny.

05.30 *Hours.* Another Turtle Dove (*Streptopelia turtur*) settled on our port bulwark, aft, and remained, preening itself; it continued with us until 07.00 hours. No petrels or any other birds were seen until 10.30 hours when a solitary Great Shearwater (*Puffinus kuhlii kuhlii*) crossed our bows flying towards the land now about ten miles distant to southward.

11.10 *Hours.* A large gull flying in the distance; it appears to be a Herring Gull moving in the direction of Derna, about seven miles to the south. There seem to be very few birds in this part of the Mediterranean; not nearly so many as in Western part.

16.30 *Hours.* When about sixteen miles from land, we put up a Small Shearwater from the water, ahead of our bows. It was sleeping, when first seen, and allowed the ship to approach closely; on awakening it flew off with rapid wing-beats, followed by wheeling glides; in colour it was dark brown, white or nearly white on the chest and underparts; undoubtedly it was a Small Mediterranean Shearwater (*Puffinus puffinus yelkouan*). No other birds were seen during the whole day. This part of Eastern Mediterranean is very deficient in bird life, at this time of year. Apparently there is less marine life too, as we have seen no dolphins or porpoises either; small flying fishes are, however, quite plentiful.

June 24, *Sunday.* Eastern Mediterranean. Lat. 35°57 N. Long. 27°53 E.

Sea calm; slight breeze from N. to N.W.; bright and sunny all day.

No bird-life at all, with the exception that the Third Officer reported seeing a Common Swallow (*Hirundo rustica*) flying over the ship during breakfast time, at about 08.30 hours.

18.30 *Hours.* When we were about sixty miles from land (the Nile Delta) another Common Swallow (*Hirundo rustica*) appeared circling the ship and attempting to settle; it was a female, in rather worn plumage and appeared tired out; eventually it settled to roost on the gun platform in our stern. This is the third swallow that has come aboard while we have been passing through the Mediterranean. The absence of bird-life, all day, has been most marked.

June 25, *Monday.* Port Said. Arrived at Port Said about 11.45 hours.

Sea calm; slight breeze from N.; bright, sunny and clear.

At 10.00 *Hours* a Common Swallow (*Hirundo rustica*) was brought to me in an exhausted condition; it is probably the one that came aboard last night. It died before it could be released near land. The first gull to meet us, as we neared port, was a Herring Gull in immature plumage, just changing to adult; it flew round us when we were about three miles from Port Said.

11.45 *Hours.* Entering the harbour, a small number of Little Terns (*Sterna albifrons*) could be seen fishing along the southern breakwater. Presumably, they would be of the typical race *albifrons*. One or two Black-headed Gulls (*Larus ridibundus*) flew round us but they were very scarce. A large tern, with a black cap, very like if not certainly, the Gull-billed Tern (*Gelochelidon n. nilotica*) was flying with an immature tern of probably the same species. There were also several immature gulls which were probably all Herring Gulls. A small number of Common Swallows (*Hirundo rustica*) were flying over the inner harbour.

While lying at our fueling berth, in the entrance to the Suez Canal, two Slender-billed Gulls (*Larus genei*) passed over us. There are remarkably few gulls or terns in the harbour—the large numbers (chiefly of Black-headed Gulls (*Larus ridibundus*) seen by me in March last are entirely absent. *About* 16.30 *Hours,* when it became cooler, a few more gulls appeared, nearly all immature. One seen closely was an Immature Herring Gull; others seen in the distance may have been of a smaller species. Other species of birds observed in the harbour area, were:—

(1) Egyptian Kites (*Milvus migrans aegyptius*)
(2) Crows (*Corvus* sp)
(3) Sparrows (*Passer domesticus niloticus*)
(4) A number of Little Terns (*Sterna a. albifrons*) and
(5) A few Common Swallows (*Hirundo rustica*).

At 17.45 *Hours,* a fine Black-backed Gull (*Larus marinus*), in fully adult plumage, circled over the ship, closely. One or two of the immature gulls in the distance may also have been of this or of the smaller species. In the lagoon, several miles to the north-eastwards, a small party of nine to twelve Flamingoes (*Phoenicopterus ruber antiquorum*) can be distinguished; in March last there were hundreds (if not thousands) of flamingoes in this lagoon. We left Port Said and entered the Canal at dusk.

June 26, *Tuesday*. Gulf of Suez. Lat. 29°27 N. Long. 32°35 E.

Slight breeze from W. and N.W. Bright and sunny.

At 05.45 *Hours*, near El Chulaf, a Canal Station about 20 miles from Suez, we saw the first Egyptian Brown or White-eyed Gull (*Larus leucophthalmus*) a solitary bird. Soon afterwards, however, a flock of about 30 passed us flying low, westwards, up the Canal. Other flocks and solitary birds were seen, commonly, as we approached Suez. White Cattle Egrets (*Bubulcus ibis ibis*) were feeding in some of the Canal-side, irrigated fields. A pair of Pied Kingfishers (*Ceryle rudis rudis*) hovered over the water close by and Crested Larks (*Galerida cristata nigrieans*)were singing on the mounds of soil, beside the Canal. In a lagoon near Suez Town, a giant wader—either a large stork or a giant heron was standing; it was blackish all over, with reddish or pinkish legs as far as could be distinguished but it was too far away to be seen plainly; it appeared twice the size of a Grey Heron (*Ardea cinerea cinerea*) which was standing near it. Leaving the Canal and steaming to our anchorage in Suez Bay, a large sooty-brown skua flew fairly close to us and settled on the water, amongst a party of Brown Gulls (*Larus leucophthalmus*). In colour, it was sooty-brown all over, with the cap very little darker than the remainder of the head and underparts very little lighter than the upper parts. The two central tail feathers projected some four or five inches beyond the remainder and were twisted from the horizontal to the vertical. This would appear to be the dark form of the Pomatorhine Skua or Jaeger (*Stercorarius pomarinus*). Hundreds of Brown Gulls, in Suez roadstead, were in small and large parties, sitting on the water or seeking their food amongst the refuse from the ships. No other species of gulls could be seen.

At 09.30 *Hours*, as we were leaving Suez anchorage, however, a lesser Black-backed Gull (*Larus fuscus*), in adult plumage, was seen flying towards the cliffs and two immature gulls, probably of the same species, or young Herring Gulls, were circling a large warship. As we cleared the other shipping, in the outer anchorage, a party of five large dark birds were on the water; they flew off at our approach and seemed to be skuas; the middle feathers of the tail, appeared to project considerably but we were not close enough for a satisfactory view. In colour they were dark, sooty brown above and whitish below—wings long and pointed. Would any species of skua be in these waters, in small flocks, at this time of the year?

At 10.45 *Hours*, when we were 12 to 13 miles from Suez we passed a flock of about a dozen Brown Gulls (*Larus leucophthalmus*) accompanied by two skuas; the Brown Gulls rose and followed the ship but the skuas disappeared. All the Brown Gulls were in adult plumage. Do they breed in this vicinity?

11.15 *Hours*. Amongst the small party of Brown Gulls, accompanying the ship, was an immature bird, with black-tipped tail and smoky brown plumage. Between 17.30 and 18.15 hours, many large terns passed us, flying from the direction of Ras Gahrib, towards the Sinai coast; they were mostly in pairs and flew close over the water, occasionally rising 20 feet or more into the air and plunging down into the sea; they seemed to be largish sea terns, pure white, with the exception of a light-grey mantle; tail long and forked; beak red; head may have had a black cap, but it could not be distinguished accurately. I think that they were Lesser Crested Terns (*Thalasseus bengalensis*). A few Brown Gulls continued to accompany the ship all day, flying close above our stern or in our wake.

June 27, *Wednesday*. Red Sea. Lat. 25°47 N. Long. 35°12 E.

Slight sea; fresh breeze from N.W.W. to E. and S.S.E. Bright, sunny but cool.

05.00 *Hours*. No birds seen during the early morning, but as the sun rose, four Brown Gulls appeared and, soon afterwards, a dozen were with us. They were very tame. They appear to follow ships down the Red Sea, sleep on the water and then to join other ships going up and return to Suez; they feed on the refuse in the wakes of the ships.

08.00 *Hours.* Passing the Brothers Islands, at about 2 miles, distance, 30 to 40 Brown Gulls, all in adult plumage, joined the ship. Do these gulls nest on these Islands? They are very plentiful in the vicinity. A large, sooty-brown bird, with whitish underparts and a longish pointed tail, passed near us—a skua of some species, I think; probably the Arctic Skua (*S. parasiticus*).

By 09.30 *Hours* when the Brothers Islands had just disappeared out of sight, astern, the Brown Gulls had thinned out considerably; they are evidently loath to leave the vicinity of the Islands. By 13.00 hours all had disappeared.

At 14.15 *Hours* two Brown Gulls appeared, one adult and one immature, with completely brown mantle with no white hind margin; white tail black-tipped; beak greenish.

14.00 *Hours.* Some seabirds, some distance away, appeared to be brown above, whitish below with tails longish and sharp pointed. Several more of the same species were in the far distance; later a small flock of seven of these birds passed a few hundred yards from the ship; the tail is forked; the head is black-capped and the upper plumage, including the tail, is dark earthy brown; primaries blackish; the neck is lighter and the underparts are whitish; the beak dark;—this is evidentally the Red Sea Brown-winged Tern (*Sterna anaetheta fuligula*).

15.30 *Hours.* Three more Brown-winged Terns passed; all flying N. W. close over the water.

15.50 *Hours.* Another 5 Brown-winged Terns were flying in the same direction. No Brown Gulls were seen after 15.20 hours but several parties and pairs of Brown-winged Terns passed just before dusk.

June 28, *Thursday.* Red Sea. Lat. 21°59. Long. 37°41 E.

Sea calm; slight breeze from S; bright, sunny and clear. No birds at all were seen between sunrise (about 05.00 hours) and 11.00 hours.

At 11.05 *Hours,* 5 petrels were in our wake; they were largish, dark sooty-black with a distinctly lighter pattern across the wings; the rump was white; the feet were longer than the squarish tails, the toes projecting half inch or so; these petrels appear to be of the same species that we saw, so commonly, in the Atlantic and in the Western Mediterranean, i.e. Wilson's Petrel (*Oceanites oceanicus*).

At 11.20 *Hours,* 4 Aden Sooty Gulls (*Larus hemprichi*) passed us flying close over the water towards Gebel Asetariba on the African shore. They were all immature; the tails were pure white and the margins of the sooty-brown wings were also white.

At 11.30 *Hours,* a fine young Peregrine Falcon (*Falco peregrinus*) came aboard, flying in from the Arabian Coast. After circling the ship for some minutes it took up a commanding position on the top of the aftermast, where it remained for a considerable time. It was, I feel certain, a ♀ in immature plumage—probably a this year's bird; back, wings and tail were dark rufescent brown, darker and more brown than (but marked rather like) a European Kestrel; breast light fawn, lighter on the chest, darker on the abdomen and lighter again towards the vent, striped with interrupted wavy, longitudinal dark brown or blackish streaks; throat and foreneck light, yellowish white or whitish fawn; crown of head dark brown, deepening to blackish on the sides and black moustachial stripe well marked; hind neck spotted or streaked with dark brown on light fawn; beak dark brown with light yellow cere; eyes dark, with bright bluish lids; tarsus and feet light greenish yellow; lower abdomen light fawn; size about that of a smallish Carrion-Crow (*Crovus corone*).

After remaining on the aftermast until about 14.50 hours, it tried a number of alternate perches and eventually settled down again, in the shade, on the top of a big ventilator, forwards, where an excellent view of it was obtained. The wings were dark, dull lead or slate-brown with the feathers edged with light-reddish brown; the tail was the same colour as the body, but closely barred with reddish brown, with the tips of the feathers light. Head was dark brown at the sides, with the back of the crown bright golden purplish-brown and the fore-head light brown; the thighs were bright fawn, slightly spotted near the body, when flying this falcon gives the impression of being dark brown above, with the tail barred and the underparts also closely barred. It left us about 15.00 hours.

Between 15.00 *and* 15.15 *Hours,* we passed through areas of the reddish plankton from which the Red Sea takes its name—also we passed vast numbers of small purple jelly fish.

All afternoon, several petrels were in our wake; they were generally in pairs.

10.55 *Hours.* A Common Swallow (*Hirundo rustica*) circled over the ship, several times, and then made off southwards, mounting high into the sky.

18.00 *Hours.* Several petrels were in our wake—the number varying from 2 to 6; they keep more or less in pairs but a little distance away from the ship one pair was slightly smaller and darker than the others, with more pointed wings and feet not projecting beyond the tail (which appears squarish or very slightly forked). They may be Storm Petrels (***Hydrobates pelagicus***) which, I believe, occur in these waters; remainder appear to be the common Wilson's Petrel (*Oceanites oceanicus*).

June 29, *Friday.* Red Sea. Lat. 17°57 N. Long. 40°03 E.

Sea moderate; fresh breeze from N.W.; sunny but hazy owing to dust.

At sunrise, about 05·45 *Hours,* 30 to 40 petrels in our wake.

06.15 *Hours,* 3 Brown-winged Terns (*Sterna anaetheta fuligula*) passed by, flying N.W.

At 09.00 *Hours* I spent a long time, very carefully observing the 30 to 40 petrels flying in our wake. They all appeared to be Wilson's. Coloured above, dark sooty brownish black, with lighter markings across wings; markings can be seen only in a good light; large white rump; tail appears very slightly forked, but may be square (not easy to determine with birds in flight); feet appear black; they project nearly ½ inch beyond tip of tail; underparts dark sooty brown.

At 11.15 *Hours* there were still about 10 to 20 of these petrels in our wake; from 09.00 to about 11.00 hours the maximum number was about 50. Do any petrels nest on Red Sea islands—or are they all migratory?

During morning several small flocks of Brown-winged Terns were passed flying N.W. No other birds were seen.

At Midday it was very hot and muggy, with a following wind and much dust haze; visibility was reduced to about 1½ miles; temperature was over 95°.

16.05 *Hours.* A Tropic Bird appeared some distance away; it was probably either ***Phaethon rubricauda*** or ***P. lepturus.***

Between 16.00 and 17.00 *Hours* we passed 8 Brown-winged Terns, 1, 2, 3 and 4; 4 were standing on two small bits of planking, floating past the ship. Many petrels are still in our wake.

18.15 *Hours.* Another Common Swallow (*Hirundo rustica*) flew close over the ship and disappeared astern; it was flying N. or N.W. Now 40 to 50 petrels are in our wake, feeding on the refuse thrown over from the ship.

19.30 *Hours.* A small party of Brown-winged Terns settled in our wake; the head is partially black but the forehead is white; the beak black and the wing lining is whitish. The petrels remained in our wake until it became too dark to see them any longer.

June 30, *Saturday.* Red Sea. Lat. 14°24 N. Long. 42°34 E.

Sea calm; light breeze, variable; bright and sunny; dust storm has abated and visibility has improved to 3 to 4 miles.

05.20 *Hours.* Between dawn and sunrise, one gull and six petrels were in our wake; the gull is plain, sooty brown, with greenish beak; an immature Aden Sooty Gull (*Larus hemprichi*), I think—not an Egyptian Brown Gull (*L. leucophthalmus*) but the tail completely white. The petrels are all Wilson's (***O. oceanicus***).

06.00 *to* 06.15 *Hours.* Three Brown-winged Terns (*S. a. fuligula*) and two smallish white terns, with grey mantles—very like the Roseate Tern (*Sterna dougalli korustes*) passed nearby. Also saw one shearwater and an immature gull—probably a young Lesser Black-backed Gull; in colour it was mottled brown and white above, dirty white on underparts, head and neck greyish white, tail white with black tip. The shearwater was brown above, whitish below; it flew close above the water, flapping and gliding, (not flying like a Mediterranean Shearwater (*P. k. kuhlii*)—possibly a Wedge-tailed Shearwater (*P. pacificus*).

06.15 *to* 06.30 *Hours.* Passed a string of 9 and several single Masked Boobies, all heading S.W.; all were dark chocolate brown above with belly white; head and neck dark chocolate brown; primaries and tail blackish; all in immature plumage except one which was in the mature, white plumage, with black flight feathers and tail; this is evidently the Red Sea Masked Booby or Gannet (*Sula dactylatra melanops*). Many medium sized terns passing, at some distance, generally in pairs, white except for light grey mantle and head with small black cap: beak orange yellow—the Lesser Crested Tern (*Thalasseus b. bengalensis*) by the look of them, but I cannot be certain, nor do I know whether this tern breeds in the Red Sea. An Aden Sooty Gull (*Larus hemprichi*) has just appeared, following our wake. It is somewhat like the Brown Gull (*Larus leucophthalmus*) of Egypt, being predominantely sooty brown, but this bird has the head brown, not black, divided from the body by a narrow white collar; bill is bright greenish with a red spot towards the tip, divided from the green by black.

07.50 *Hours.* An adult Masked Booby (*S. d. melanops*) crossed our bows; bill is light-greenish; many terns (*S. b. bengalensis* ?) all round us but not very close. Boobies now very common, chiefly immature but a fair sprinkling of adults—ratio about 10 : 1. Four Brown Gulls close in our wake—immature with black-barred tails; mantle and body rather dirty, sooty brown with white underparts. We are now passing Zubair Islands. All Boobies flying away from them to fishing ground (presumably). Presumably this species nests on these Islands; 2 or 3 petrels still following our wake.

Soon after 08.00 *Hours,* after passing the last of the Zubair Group a party of 12 or more Aden Sooty Gulls (*L. hemprichi*) flew out to us and followed our wake; very tame, flying close over stern; all but one immature, but some in more advanced plumage than others.

08.45 *to* 09.00 *Hours.* Nine Sooty Gulls and 7 or 8 petrels feeding together, in our wake, on refuse thrown overboard. Both species alighting on water to scramble for food. One Brown-winged Tern (*S. a. fuligula*) and 3 Indian Lesser Crested Sea Terns (*Thalasseus b. bengalensis* ?) flying past. Boobies have all disappeared.

10.45 *Hours.* Passed large shoal of large mackerel (sp.) leaping out of water after small fish. Above the shoal were 20 to 30 medium sized terns (*T. b. bengalensis*?) and an immature Sooty Gull. Later terns settled down, on the water, in a small compact flock. Now 6 Sooty Gulls (*L. hemprichi*) are in our wake, 4 adults and 2 immature and also several petrels.

11.00 *Hours.* All gulls gone. They settled on water and were left behind; does this gull nest on the Zubair Group? Six petrels still in our wake.

11.25 *Hours.* Tropic Bird, flew away from ship; appeared pure white with long white tail feathers—so was probably the White Tropic Bird (*Phaethon l. lepturus*).

11.45 *Hours.* Three petrels and one Sooty Gull in our wake.

11.50 *Hours.* Another shoal of large mackerel (sp.) leaping after small fish. Above were 4 Brown-winged Terns and 2 terns that looked like the Gull-billed Tern (*Gelochelidon n. nilotica*) but they may have been the White-cheeked Tern (*Sterna repressa*); white except for mantle (rather slate-grey) and head with black cap, beak blackish.

12.30 *Hours.* About 12 Sooty Gulls circling ship in our wake with 6 petrels. A few Brown-winged and Lesser Crested Terns passing occasionally.

Between 13.30 *and* 14.00 *Hours.* While passing Gebel Zuqab at less than one mile, large numbers of Sooty Gulls joined us, many settling on boats, masts and upper structure; 8 petrels in our wake; many boobies, all in immature brown plumage, flying about and settling on water. Several Brown-winged Terns near the Island. Later, large flocks of Brown-winged Terns passed, with one adult booby and a number of Lesser Crested Terns (?).

In one large flock of Brown-winged Terns were 4 sooty-brown birds of considerably heavier build and larger size; they appeared brown or grey-brown both on underparts as well as upper; they seemed to be shearwaters of some species—possibly the Wedge-tailed or Green-billed Shearwater (*Puffinus pacificus* *hamiltonii*) which is, as far as I am aware, the only shearwater likely to be seen in these waters, in any numbers.

15.45 *Hours.* Tropic bird, with red-bill and long white tail feathers flew close across our bows, giving an excellent view—definitely the White Tropic Bird (*P. l. lepturus*); a beautiful bird.

Shortly afterwards passed several large concourses of sea-birds, following shoals of small fish; several boobies, many Sooty Gulls, great numbers of Brown-winged Terns and the orange-billed terns which, I think, are the Lesser Crested Sea Terns (*T. b. bengalensis*). Amongst the terns were a number of the sooty-brown birds that appear to be shearwater; they are dusky or sooty-brown all over; tail is rather long and pointed, wedge-shaped, I think; beaks long and fairly stout; I presume that they must be the Wedge-tailed or Green-billed Shearwater (*P. pacificus hamiltonii*). Do these shearwaters breed in the islands in the vicinity or do they migrate, breeding in winter in the Southern Hemisphere? There were 30 to 40 of them in this flock. Many Sooty Gulls continue to accompany us, settling all over our upper structure; very tame. Many petrels in our wake.

July 1, *Sunday.* Gulf of Aden—Aden at midday.

Moderate sea; slight breeze from N.W.; bright; clear and sunny.

05.45 *Hours.* Before sunrise, while still about 28 miles from Aden, many petrels in wake and flying over surrounding sea, all seemed to me Wilson's (*O. oceanicus*); no Sooty Gulls; tropic bird, flying high and very rapidly; also single shearwater, moderate in size, dusky brown above and below, wheeling over water—presumably *P. pacificus hamiltonii.*

06.30 *Hours.* Common Swallow (*Hirundo rustica*) flew close round ship; last seen mounting high skywards, towards land about 20 miles away port-side. What is a swallow doing here at this time of the year?

06.50 *Hours.* Five Sooty Gulls joined us, 4 immature, one adult; settled on water. Entering Aden roadstead, several Large-crested Sea Terns (*Thalasseus bergii velox*) passed. Petrels accompanied us in amongst other ships anchored in outer harbour and remained feeding, like gulls, on refuse thrown overboard. Comparatively few gulls, in harbour—very different to last March. No Black-headed Gulls (*L. ridibundus*) now, but small numbers of Sooty Gulls (*L. hemprichi*) flying in all directions; majority in immature plumage; also several large gulls in immature plumage (probably *L. fuscus*) and a single Black-backed Gull (*Larus fuscus*) in full adult but noticeably worn plumage.

In distance many terns, chiefly Large Crested Sea Terns (*T. bergii velox*) and (I think) Lesser Crested Terns (*T. b. bengalensis*); also a single Masked Booby (*S. d. mlelanops*), in adult plumage, near one of the mooring buoys.

12.00 *Hours.* Leaving Aden a medium sized dusky brown shearwater (*P. pacificus hamiltonii*) I think, crossed our stern.

Between 15.30 *and* 16.00 *Hours* many pairs of Large Crested Sea Terns (*T. bergii velox*) and Lesser Crested Terns (*T. b. bengalensis?*) flying past, also many petrels (*O. oceanicus*) flying in our wake.

16.50 *Hours.* Large flock of Brown-winged Terns (*S. a. fuligula*) fishing at a little distance from the ship, together with a few Large Crested Sea Terns and one Tropic-bird (sp. uncertain). Tropic bird was observed to dive into water. Also many petrels (Wilson's) in our wake, wheeling over surrounding seas.

17.10 *Hours.* Common Swallow (♂) (*Hirundo rustica*) settled on foremast stay, then circled up and disappeared astern. We are now roughly 300 miles from Arabian Coast. Wind S.S.E. a moderate breeze; later swallow re-appeared and remained with us until after 18.45 hours, when it finally left. Surely it is unusual to find swallows (*H. rustica*) in these waters at this time of the year?

18.15 *Hours.* Many petrels still in our wake; some Brown-winged Terns passing; petrels remained with us until after dark when it became too dark to see them longer.

July 2, *Monday.* Gulf of Aden. Lat. 12°37 N. Long. 49°22 E.

Slight swell; very light breeze from N.E. to S.E.; bright, clear and hot.

05.30 *to* 07.30 *Hours.* Many petrels in our wake and skimming over swell;

all Wilson's (*O. oceanicus*); several flocks and many pairs of Brown-winged Terns, fishing and flying in various directions.

07.30 *Hours.* Several medium sized shearwaters, wheeling low over water in various directions; uniform dusky-brown above and below—evidently Wedge-tailed or Green-billed Shearwaters (*P. pacificus hamiltonii*); one Tropic-bird (sp. uncertain) flying high and plunging down, fishing, near flock of Brown-winged Terns.

During morning, many petrels, a number of Brown-winged Terns and several shearwaters flew past mostly at some distance.

All petrels still continue to be Wilson's Petrel (*O. oceanicus*) as far as can be seen. There must be many thousands of this species in these waters and in the North Atlantic. I had not before realised what a common bird this petrel is.

Afternoon. Very many petrels still in our wake and scattered over surrounding sea; 30 to 40 always following us. One shearwater (*P. pacificus hamiltonii*); one Tropic bird flew away at our approach and settled again; tail shorter than in White Tropic bird (*P. l. lepturus*) seen in Red Sea and back barred black, evidently the Short-tailed Tropic-bird (*Phaethon indicus*). Several more shearwaters (*P. pacificus hamiltonii*); two Brown-winged Terns and one rather large tern, with light grey mantle and yellow beak (sp. uncertain). Many petrels still in our wake.

17.30 *Hours.* Two more Short-tailed Tropic birds (*Phaethon indicus*) crossed our bows, giving us a good view of them.

18.15 *Hours.* Passed large and noisy concourse of sea birds, following large shoal of small fish. Large mackerel (sp.) also chasing the same shoal and a school of porpoises and/or dolphins appeared to be chasing the mackerel; sea birds, chiefly Brown-winged Terns (*S. anaetheta fuligula*) a single Masked Booby and several shearwaters—all *P. pacificus hamiltonii,* uniformly dusky above and below.

July 3, *Tuesday.* Arabian Sea. Lat. 13°37 N. Long. 53°37 E.

About 40 miles N. of Socotra. Stiff breeze from S; sea rough, heavy monsoon swell; bright and sunny; visibility moderate.

06.00 *Hours.* Two (pair ?) Short-tailed Tropic-birds circled close to ship; excellent view; disappeared south.

08.30 *to* 09.15 *Hours.* One Tropic-bird, in distance. One (possibly two) Wilson's Petrels crossing bows; no petrels in wake. Three or four Green-billed Shearwaters (*P. pacificus hamiltonii*) wheeling over swell, occasionally close to ship.

This morning a new species of shearwater has appeared; very similar in size and colour to the Small Shearwater (*P. puffinus*) which we saw in the Western Mediterranean; this bird is rather small in size, lightish brown above and whitish below; it flew more rapidly and with less sailing and wheeling than the much larger Green-billed species. We are now about 40 to 50 miles N.W. of Socotra, so I imagine that this small shearwater must be connected with this Island. Five or six of them were passed this morning, none close. I think they must be the local race of the Dusky Shearwater (*Puffinus assimilis bailloni*). No other birds were seen until 11.55 hours when a single Green-billed Shearwater passed.

Between 17.30 *and* 19.00 *Hours,* when dusk set in, there were a few Green-billed Shearwaters, flying low over the waves, but no other birds; petrels were conspicuous by their absence.

July 4, *Wednesday.* Arabian Sea. Lat. 15°45 N. Long. 57°17 E.

Roughly 200 miles S. E. of Arabian coast; swell heavy but moderating; strong monsoon wind from S.W.; morning dull; visibility fair; later, bright and sunny.

06.00 *to* 08.00 *Hours.* Passed several dark-coloured shearwaters; all presumably Green-billed (*P. pacificus hamiltonii*); one settled on the water; these shearwaters have rather long, squarish tails.

08.30 *to* 11.00 *Hours.* Passed one Tropic-bird (*P. indicus*) and several petrels (*O. oceanicus*) flying low over the swell; none in wake. Many shearwaters, generally solitary or in pairs, but one gathering of upwards of 12, passed at 10.45 hours. In this group, majority were settled on water although it is still rather rough, others were flying on overhead, settling and getting up again.

14.30 *to* 15.00 *Hours*. In addition to numerous shearwaters passed a Short-tailed Tropic-bird and 5 (2, 1, 1, 1) Masked Boobies, all in adult plumage, fishing by diving vertically from a height and disappearing completely under water. Some shearwaters appeared rather larger than others; one large one, passing close, could be seen to have flesh-coloured feet. Does the Pink-footed Shearwater (*P. carneipes*) ever come as far as west as this?

15.30 *Hours*. Passed another large concourse of sea birds close to starboard, chasing a shoal of small fish which was also being chased by large mackerel (sp.); 40 to 50 Green-billed Shearwaters, with which were a few of the slightly larger species which appeared also slightly lighter brown; there were also a pair of Brown-winged Terns and a pair of small shearwaters not seen before. These two shearwaters were strikingly black and white, very like the Manx Shearwater (*Puffinus puffinus*) in size and colour, the dark blackish upper parts contrasting very vividly with the white of the underparts; they were flying with the other shearwaters but kept together. We are now running roughly 225 to 250 miles from the Arabian coast. I think these must be the Persian Shearwater (*Puffinus persicus*), which answers to this description.

16.05 *Hours*. Two petrels (*O. oceanicus*) following our wake; passed three other birds—petrels or very small shearwaters—that are new to me, flying more or less together, close above the waves, at a little distance from the ship; somewhat like shearwaters of the *Puffinus puffinus* group but, while underparts are white or whitish, mantle and upperparts generally are grey, with blackish primaries. They appeared to be either very small shearwaters or more probably petrels of some species.

Shortly afterwards, we passed another of the same species and also numerous Green-billed Shearwaters.

Between 16.45 *and* 17.00 *Hours* passed three Short-tailed Tropic-birds (*P. indicus*) one of which sat on the water until we were quite close to it; as it rose and flew off, it gave us a splendid view; numerous Green-billed Shearwaters still present together with one or two petrels.

17.30 *Hours*. Another Tropic-bird (*P. indicus*) passed, but shearwaters are now becoming very scarce as evening closes in; sea has moderated and it is now bright and sunny with good visibility; breeze is strong from S.W.

July 5, *Thursday*. Arabian Sea. Lat. 18°29 N. Long. 60°25 E.

Roughly 200 miles from Arabian coast; swell moderate; breeze moderate from S. W.; bright and sunny; visibility good.

This morning we have passed into the territory of another species of petrel.

Between 06.00 *and* 07.00 *Hours*, saw 15 of them, either singly or in pairs, flying close over the waves like Wilson's Petrels, mostly at a little distance from ship. They are very similar in size to, but possibly a trifle smaller than, Wilson's Petrel (*O. oceanicus*) and, like that bird, are sooty blackish-brown above with a white rump; but the indistinct pattern in the wings is less distinct in this species; the belly and abdomen are white and there is also a white lining to the wings; feet appear to be black and about the same length or possibly a trifle longer than the tail; tail is square or possibly very slightly forked. I have not met this petrel before but it seems to be common in these waters. The only petrel mentioned by Stuart Baker in the *Fauna of British India, Birds*, Vol. VI, which it might be is the Dusky-vented Petrel (*Fregatta tropica melanogastra*).

Many Green-billed Shearwaters are still present—but no other shearwaters.

At 06.40 *Hours*, passed a large concourse of these shearwaters (*P. p. hamiltonii*); more than I have ever seen together previously; there were well over 100 of them, either settled on the water or wheeling overhead, all in a large loose flock.

08.00 *Hours*, passed a lone gull; apparently a Sooty or Aden Gull (*L. hemprichii*) in immature plumage.

08.45 *Hours*. Three Short-tailed Tropic-birds (*P. indicus*) flew over and circled the ship for upwards of 5 minutes before dropping astern; they showed themselves off very well; short tails were very noticeable. Shortly afterwards another pair passed, so this species of Tropic-bird seems fairly plentiful in this area. A number of Dusky-vented Petrels (?) and Green-billed Shearwaters were in evidence throughout the morning but not a great many of either species.

Between 15.00 *and* 16.15 *Hours*, passed 5 Dusky-vented Petrels (?), one of which flew to and fro across our wake for upwards of 5 minutes. Several Green-billed Shearwaters, one Short-tailed Tropic-bird and five Masked Boobies (*Sula dactylatra melanops*), all in adult plumage, two together and the remaining three solitary birds. Dusky-vented Petrels (*F. tropica melanogastra?*) still fairly numerous, often in pairs but generally singly. We are now roughly 150 miles from Arabian coast; swell continues; with bright and moderately sunny sky.

16.20 *Hours*, passed 4 Dusky-vented Petrels (?) flying more or less together; Green-billed Shearwaters are becoming scarcer as we travel further north—possibly we are running out of their usual habitat.

From 17.30 *to* 20.00 *Hours* (*dusk*) passed one Short-tailed Tropic-bird, one Green-billed Shearwater and several (5 or 6) Dusky-vented Petrels (?).

July 6, *Friday*. Arabian Sea. Lat. 21°23 N. Long. 63°42 E

Roughly 24 hours from Karachi; sea calm; swell moderate; light breeze from S.W.; fine, fairly clear but sky inclined to be overcast.

06.00 *to* 07.00 *Hours*. Bird-life very scarce, this early morning; no shearwaters; only one Dusky-vented Petrel (?) seen.

07.45 *Hours*. Two Short-tailed Tropic-birds appeared and circled the ship, near or far, for nearly 15 minutes, before dropping astern.

09.00 *Hours*. Masked Booby, flying N.E., overtook ship. This bird appeared to have more white on it, than usual, especially about the tail; tail coverts were white and only the ends of the tail feathers were black, like the primaries; bill was bluish.

09.40 *Hours*. Solitary Green-billed Shearwater crossed our bows; shortly afterwards a single Dusky-vented Petrel (?) appeared. Later two more Dusky-vented Petrels (?) were passed, but there are not so many of these petrels about today as there were yesterday.

10.55 *Hours*. Pair of Short-tailed Tropic-birds flew over ship, calling loudly to one another, and then circled ship for 10 minutes or more. Call is monosyllabic and rather finch-like—not the type of cry one would expect from a bird like the Tropic-bird.

13.45 *Hours*. Two Green-billed Shearwaters and several petrels round bows; two of petrels were definitely the species that I have called Dusky-vented (*F. t. melanogastra*) and one was definitely a Wilson's (*O. oceanicus*) while another was also, I think, of this species. The fifth was a slightly larger, grey petrel, of the same species recorded as having been seen at 16.05 hours on 4th July. This one was closer and could be seen much better; the underparts were white, like the Dusky-vented Petrels close to which it was flying, but the upper parts were mottled bluish grey, with dark primaries; head and hind neck were lighter grey; rump was pale grey or whitish and tail was blackish; feet were slightly longer than the tail. I think that this bird (and those seen on the 4th July) must be the White-faced Storm or Frigate Petrel (*Pelagodroma marina*) which is known to occur further south in the Indian Ocean.

13.30 *to* 15.00 *Hours*. Exceptionally few birds passed; only three Dusky-vented (*F. t. melanogastra* ?) and one Wilson's (*O. oceanicus*) noted.

After 15.00 *Hours* more birds appeared. Two Green-billed Shearwaters, crossed our bows, followed by several petrels of which one was a Wilson's and 3 or 4 were Dusky-vented (?). Then three more White-faced Petrels (*Pelagodroma marina*) appeared flying together to starboard. They are attractive little petrels with, as far as one could see, flight and habits at sea similar to those of Wilson's, with the exception that they flew straighter and more purposefully.

15.40 *Hours*. A Masked Booby and a solitary Short-tailed Tropic-bird circled the ship, widely, flying more or less in company. For some days we have had a small number of butterflies, moths and locusts with us. They came aboard when we were in the Gulf of Aden and are still with us, though the number of locusts (some pink and others yellow) has diminished. The locusts came aboard chiefly (if not entirely) at night.

16.00 *Hours.* Two Masked Boobies and one Tropic-bird flying in our wake.

16.10 *Hours.* A single Masked Booby came floating past, standing on a plank; it took to flight as it came amidships and circled round. All the boobies seen, during the last few days, have been in fully adult plumage. Several petrels both Wilson's and Dusky-vented (?) crossed our bows between 16.00 and 17.00 hours.

17.45 *to* 19.00 *Hours.* Three Green-billed Shearwaters and one Short-tailed Tropic-bird passed, all flying singly. The Mekran coast is now about 200 miles away.

July 7, ***Saturday.*** Arabian Sea. Lat. 24°47 N. Long. 66°32 W.

Approaching Mekran coast and Karachi. Sea much calmer; slight swell; slight ripple from light breeze, from S.E.; sky overcast and cloudy, early morning, brighter later; warm and muggy.

05.30 *to* 06.00 *Hours.* Roughly 70 miles from coast; Green-billed Shearwaters, very numerous; passed several hundreds, mostly flying but one flock of 12 and another 7 were resting, on the water, in compact groups.

As soon as the birds in these flocks took wing, they scattered and flew away singly or in pairs; they did not fly in flocks, but seemed to like to rest in these formations. Petrels still numerous, but now all appear to be Wilson's; we passed upwards of 50 in half an hour, mostly flying singly or in pairs, but at one time there were seven skimming the water, close together.

Soon after 06.00 *Hours,* two Masked Boobies sailed up from astern, overtook and inspected the ship and then dropped back again.

06.15 *Hours.* A large skua (?) crossed our bows, at a little distance and proceeded on its course; it was a little larger and more heavily built than the Green-billed Shearwaters; dusky-brown above (like that shearwater but of a rather lighter ashy brown) below whitish—not pure white but the brown of the sides fading into dirty white. I take this bird to be Richardson's Skua (*Stercorarius parasiticus*) but it is surprising that one should be in those waters early in July; presumably it was a non-breeding bird that had remained behind in its winter habitat.

Between 06.00 *and* 06.45 *Hours.* Green-billed Shearwaters and Wilson's Petrels continued to be numerous—but not as plentiful as they were earlier in the morning. After 06.45 Hours only an occasional shearwater and petrel was seen.

At 07.00 *Hours,* a small shearwater crossed our bows, flying rapidly close above the water with quick wing beats and short glides. It was blackish brown above and white beneath and was, I believe, another Persian Shearwater (*Puffinus persicus*).

07.45 *Hours.* Another Masked Booby flew up, inspected the ship and dropped astern; a few Wilson's Petrels are still flying around.

Between 08.30 *and* 09.05 *Hours* only one or two Wilson's Petrels were observed; other birds had disappeared.

At 09.30 *Hours* an empty oil-drum was thrown over and floated away astern. This intrigued a Masked Booby, which flew up and inspected it for some minutes; then settled beside it and eventually flew up and settled on it and drifted away, out of sight, astern. The Masked Booby seems to be full of curiosity.

Until 11.50 *Hours,* saw no further birds, with the exception of 4 or 5 Wilson's Petrels, which flew to and fro across our wake for over an hour. Land appeared, in a dust haze, about 11.45 hours but could not be seen properly until we were passing within 15 miles of Monze Point. Bird-life was noticeably absent while we were coasting towards Karachi. Only one Wilson's Petrel was observed until 13.10 hours when we passed two Sooty Gulls (*L. hemprichii*) on the water; they flew away astern.

At 13.15 *Hours,* when Karachi, had just become easily distinguishable through the dust haze, a pair of Large Crested Sea Terns flew by, close to the ship, and three smaller, greyish terns passed ahead of us. The Large Crested Sea Terns, in these waters, would be the local resident race, the

Mekran Large Crested Tern (*Thalasseus bergii bakeri*) but I could not identify the smaller grey terns. Immediately after seeing the terns, a single Wilson's Petrel, passed—the last to be seen on this voyage.

In Karachi Harbour Sooty Gulls (*Larus hemprichii*) were very numerous, so also were the Large Crested Sea Terns (*T. bergii bakeri*) and the Little Tern (*Sterna albifrons*) which, at this time of the year, would be the local breeding race *praetermissa*.

I was very interested to see, also, in this Harbour many Indian Reef-Herons (*Demiegretta asha*) mostly in the slate-grey phase; they were comparatively tame and settled on the upper-works and rigging of the ships as well as beside the water; in the evening, they retired to a large clump of peepal trees in the dock area, where they appeared to be nesting. This is presumably the same colony as mentioned by Stuart Baker (page 353, Vol. VI, Birds) *Fauna of British India* Series.

In the evening, as we lay at anchor, flock after flock of hundreds (if not thousands) of Indian Shags (*Phalacrocorax fuscicollis*) with possibly some Indian Cormorants (*P. carbo sinensis*), passed close over our mast-tops on their way to their feeding grounds in the shallow lagoons on the opposite side of the harbour—a fitting finale to a most interesting voyage.

During the voyage, and while preparing this Diary for publication, frequent reference was made to the following books:—

Birds of Canada	By P. A. Taverner.
Birds of the Ocean	,, W. B. Alexander.
Fauna of Birtish India. Birds ...	,, E. C. Stuart Baker.
Handbook of British Birds ...	,, Witherby and others.

REPTILES OF COCANADA.

BY

GARTH UNDERWOOD.

(*With two graphs.*)

The terrain consisted of a coastal strip of sand two to three miles in width. The water level was never more than about ten feet below the surface. Palms and cacti composed the principal vegetation, with patches of sparse grass. Inland was a zone of paddy fields; the mud was copious and vegetation plentiful.

The reptiles examined were collected with the aid of the local villagers and came, as far as is known, wholly from the two types of country described. The accounts of the species encountered are given in so far as they supplement or contradict the accounts given by Smith in *The Fauna of British India,* (Reptilia), 2nd Ed. Dimensions are all in millimetres.

The following abbreviations are used to reduce the bulk of the account:—

Temporals 2 + 2 and 2 + 3, 8 spp., means that 8 specimens were examined having 2 + 2 temporals on one side of the head, and 2 + 3 on the other side. Owing to the docked tails, the total lengths of snakes are not always comparable; the body and tail lengths are indicated separately thus:—

1,000 total length (b.750, t.250).

The ventral and subcaudal counts are indicated by V and C.

LORICATA.

Crocodilus palustris

In Pittapur Raja's College is the skelton of a *Crocodilus palustris* which wandered into the district. The writer was told that a few are sometimes washed down to the lower reaches by the Godavari river when it is in flood. It is not a normal inhabitant of the neighbourhood.

TESTUDINES.

Trionychidae:

Lissemys punctata

This was the only Chelonian met with. Unfortunately the Godavari river was too far distant for any specimens to be obtained from it.

96 specimens were examined. 65 of these specimens possessed developed marginal bones. They were very variable. In 11 individuals the relation of 1st to 2nd marginals was different on the two sides. Taking the sides separately, in about three-quarters the 1st marginal was larger than the 2nd. This includes about one-tenth of the total number in which the 1st was much larger than the 2nd. In about one-eighth the 1st and 2nd marginals were equal. In the remaining eighth the 1st was smaller than the 2nd. The number of separate ossifications visible varied from 6 on each side (2 spp. 150 × 120 and 230 × 185) to 12 on each side (1 sp. 190 × 150). One specimen had 3 on the left and 4 on the right (200 × 160). In 6 specimens no anal marginals were apparent. 1 specimen had no marginals at all with consequent curtailment of the posterior border of the carapace (115 × 105).

The entoplastral callosity was always small, never absent. Assuming that plastron and entoplastral callosity are approximately elliptical then:—

$$\frac{\text{length} \times \text{breadth of plastron}}{\text{length} \times \text{breadth of entoplastral callosity}}$$

gives the approximate ratio of area of plastron: area of entoplastral callosity. For specimens of over 160 mm. in length this ratio varied from 63.5 (Plastron 163 × 139, callosity 21 × 17) to 480 (Plastron 200 × 168, callosity 10 × 7). The *F.B.I.* illustration of a 'moderate' callosity gives a ratio of 20.5.

In the young the skin on the costal plates was wrinkled, extracostally it was ropy; in a few cases the ropiness extended onto the costal plates. The smallest specimen in which the ropiness had been lost was 100 × 80; the largest in which it was retained was 130 × 100.

The largest specimen encountered was 235 × 190 (Plastron 253 × 192).

All the specimens had small crescentic folds of horny skin, 4 or 5 on the underside of the wrist, 1 on the underside of the tibial region.

One specimen had clubbed feet with no claws.

The colouration, although variable, showed certain consistencies.

The ground colour on the costal plates was dark olive, sometimes lighter and greyish, sometimes darker and greenish. The following black markings were usually present, sometimes fine, sometimes thick and heavy. On the neural plates starlike markings consisting of short streaks and, when the whole was heavily marked, of triangles also. Running across the intercostal sutures short parallel streaks. On the costal plates between these streaks, spots or irregular reticulate markings or both.

Extracostally the carapace was always lighter and yellower, often a brown colour, and bore spots or reticulations.

The black markings varied in thickness, the heavy ones were usually associated with reticulate markings on the costal plates, the light ones with small spots. There were all gradations of distinctness of the markings. In about one-fifth of the specimens, these of all sizes, they vary from faint to absent.

One large specimen showed a light pile-shaped band down each intercostal suture, there were no dark marks. Another of equal size and another smaller one showed the usual dark markings fading round the edges and these light bands appearing. The largest specimen (235 x 190) did not show this.

In about equal numbers the young showed spots or reticulations. These reticulations bore no relation to the underlying costal plates; in about one-tenth of the adults these irregular reticulations persisted.

In two specimens the ground colour was yellow-green, the smaller (105 x 95) with faint spots, the larger (145 x 125) devoid of markings, except on the head.

The head normally possessed 3 parallel stripes on each side, the middle one of each set running back from behind the eye, the two upper ones converged on the occiput and then diverged forwards between the eyes, the lower stripe was usually more or less wavy and varied greatly in length. Dorsally a median stripe ran back from behind the occiput. There were usually a few small marks around the snout, sometimes also the head was sprinkled generally with small irregular marks.

There was considerable variation in these stripes.

In about half the specimens the lower of the three parallel stripes was absent. In about one-third the upper stripes did not extend forwards between the eyes. In 4 specimens the upper stripes were double making 4 parallel stripes on each side.

In about one-sixth of the specimens the median stripe was double, in about one-twelfth absent or broken up.

Detailed measurements were made of the plastral callosities of 31 specimens and their course of development noted. Only 3 specimens of length less than 95 were examined.

The smallest (65 x 50) had no callosities. In one of 80 x 70 the hypohyal callosities only were apparent. In another of the same size the xiphiplastrals were also visible. All the larger specimens had the epiplastral callosities apparent. The smallest in which the entoplastral callosity had begun to appear was 95 × 80, the largest in which it had not appeared was 120 × 100.

The epiplastral callosities appear as more or less circular, on either side of the mid-line about 10 mm. apart (100 mm. specimen). Later at about 130 mm. extensions begin to appear on either side and at about 150 mm. the callosities have expanded to meet the anterior edge of the plastron. The ratio of maximum breadth to length is then about 1:2. The distance separating them may increase in large specimens.

In the young the hypohyal callosities were relatively far from the border of the plastron and the inguinal pores lay 1-2 mm. outside the border of the callosities. With increase in size the bone extends towards the edges of the plastron, passing round and enclosing the inguinal pore. The change takes place in specimens from about 110-130 in length. Eventually the callosity extends to within several mm. of the edge, or reaches it, by which time the inguinal pore may be 10-20 mm. inside the border. The smallest specimen in which the hypohyal callosities reached the edge was 185 × 150, the largest in which they were a few mm. from the edge was 200 × 170. The hypohyal callosities also develop forwards and the relative distance between them and the epiplastral callosities diminishes with increase in size.

The xiphiplastral callosities are more or less oval in the young and the inner edges diverge anteriorly and posteriorly, they are then about 5 mm. apart. With growth in size they approach one another to a distance of, usually 2 mm. sometimes much less, they tend also to diverge less and to develop square ends.

Those specimens which, from the development of the callosities, appeared to be the oldest had them well sunk below the general level; they also had a noticeable waist where the hypohyal callosities met the edges instead of the convex outline of the young. In 2 well grown specimens the maximum width was at mid-body instead of on a line across the body passing just before the posterior plastral flaps.

The smallest specimen in which marginal bones had begun to appear was 100 × 85, the largest in which they were not apparent was 120 × 100. They start appearing from the outside inwards towards the mid-line.

This turtle was common in the paddy fields, canals and ponds of the district.

Only 1 was received with any water weed growing on it, this a filamentous alga on the soft skin around the base of the neck and forelimbs.

It was observed that in water, water was constantly being pumped in and out through the nostrils, presumably so that it might be smelt or tasted.

Some half dozen eggs were laid between the fourth week in October and the fourth week in December. Unfortunately all became addled and failed to develop.

SQUAMATA.

SAURIA.

Gekkonidae.

Hemidactylus brooki.

19 specimens were examined.

The variation in the number of labials was as in the *F.B.I.* The subdigital lamellae numbered 5 under the first digit, and 7 (2 specimens 8) under the fourth.

The colour ranged from very pale with no spots at all to brown with dark brown spots.

Hemidactylus frenatus.

This gecko was uncommon here. Only 2 specimens were seen, one had a longitudinal band down the back with wavy edges.

Hemidactylus leschenaulti.

This was much less common than *H. brooki.* 5 specimens were examined. The labials were as in the *F.B.I.* The subdigital lamellae were 6 under the first and 9 under the fourth digit. The femoral pores varied from 12-15.

There were undulating cross bars on the back and the tails of some had alternate dark and pink bands.

Two eggs were laid by one in the last week of March.

Agamidae.

Sitana ponticeriana.

This lizard was not common, probably due to the dampness. Only 2 specimens were seen.

Calotes versicolor.

This lizard was very common. 95 specimens were examined, 86 ♂ and 9 ♀.

The labials showed a wider range of variation, than given in the *F.B.I.* Taking each lip separately the counts were as follows:—

No. of labials ...		7	8	9	10	11	12	13	14	Total counts
No. of counts	Upper ...	—	—		18	79	65	8	1	172
	Lower ...	1	1	19	64	60	19	7	—	171

Taking sides of the head separately the upper labials exceeded the lower in number as follows:—

(No. of upper) (No. of lower)	+4	+3	+2	+1	0	−1	Total counts
	1	2	36	72	45	15	171

In 35 out of 85 specimens the labials on the two sides agreed with one another, in another 15 specimens there was a difference between the left and right but it was the same for upper and lower labials.

The mid-body scale rows showed the following variation in numbers:—

Mid-body scale rows	38	39	40	41	42	43	44	45	46	47	48	Totals
♂ ...	—	1	4	16	9	13	13	7	10	5	2	80
♀ ...	1	1	...	2	2	2	1	—	—	—	—	9

There is in this case no clearly defined modal value but 85% of the ♂ specimens fall within 41-46.

The dorsal crest in the ♂ was well developed. Counts were made from the first enlarged scale of the nuchal crest to the last of the dorsal crest. This last scale, although scarcely enlarged, was recognisable because it was at the end of a vertebral series and beyond it on the tail were two rows on either side of the mid-dorsal line.

The counts were as follows:—

No. of scales	46	47	48	49	50	51	52	53	54	55	56	57	Total
——	5	9	12	10	27	5	1	4	3	1	1	1	79

Although the range of variation is large the modal value is clearly defined and this count may have some value.

In the ♀ there was no distinct vertebral series of scales.

In the adult ♂ the cheeks were always well swollen.

The 85 ♂ examined ranged from 98 mm.-132 mm. The modal value was 121 mm. This was not very clearly defined however.

In 41 ♂ specimens with tail intact it varied in length from 240 mm.-393 mm. The statistical correlation between body length and tail length was ·40 which is not close.

The relation between them is:—

$$\text{Tail length} = 1.3 \times \text{body length} + 141 \text{ mm.}$$

The colour of ♀ specimens was brown with darker bands, there were two light dorso-lateral stripes and whitish spots where the transverse bands crossed the longitudinal stripes. The young were lighter in general colouring and the dorso-lateral stripes very clearly marked. In the adult ♂ specimens these markings had vanished. There was generally a black band on the throat and also black on the legs. When excited the head and neck flushed red.

With regard to the egg laying season 4 ♀ were examined on August 19th and observations recorded as follows:—

Body length.

102	Oviducts empty,	15 eggs in ovaries,	4 mm. diam.
98	do	17 do	3 mm. diam.
85	Oviducts containing	14 eggs,	14 × 9 mm.
96	do	13 eggs,	12 × 6 mm.

On August 11th egg laying was observed and has been described in the *J.,B.N.H.S.*, Vol. 45, No. 2.

Scincidae.

Mabuya carinata.

This skink was common, 16 specimens were examined.

The shields of the head all agreed in having the supra-nasals separated from one another and also, in contradistinction to what the *F.B.I.* states to be the usual condition, the prefrontals separated. The anterior loreal ranged from considerably higher than the posterior loreal to just higher and from about 1/2 to 2/3 of its length. Mid-body scale rows number 30-32, dorsal scales 38-42 and the lamellae under the 4th digit 14-16, nearly all 16.

The largest specimen was body 103 mm., tail 165 mm. The tail length ranged from 1.6 × body length in the largest specimen to 2.1 in a smaller one (Body 58, tail 120).

Riopa albopunctata.

37 specimens of this common skink were collected and are now in the Society's collection. They were not thoroughly examined as regards squamation but colouration was noted.

The back was bronze brown to a width of 8 scale rows, diminishing to a width of 4 on the tail. At the base of each scale was a small darker spot. From the side of the neck on to the side of the body was spotted black and white, becoming indistinct past mid-body. The sides and underside of the tail bore small brown spots, one per scale. Some individuals had bright lemon yellow from the sides of the neck halfway to the groin.

Juveniles differed slightly from this description. They were dark bluish bronze above with seven lighter lines from neck to base of tail; the outer pair started from the corners of the eyes. The tail was dark crimson lake.

These lizards were found principally in damp situations under dead leaves.

Riopa punctata.

21 specimens were collected and are also in the Society's collection.

They had 4 rows of dark spots down the back, the dorso-lateral stripes from the canthus were well marked; on the sides, legs and base of tail were small brown spots which thinned out on the underside. On the sides of the anterior half of the body were small white spots. In the young the tail was bright vermilion, with age the colour faded and the brown spots extended over the tail. The vermilion colouration persisted in individuals of as much as 70 mm. body length.

This common skink was found principally in somewhat dryer situations than *R. albopunctata*.

SERPENTES.

Typhlopidae.

Typhlops braminus.

48 specimens were collected and are now in the Society's collection.

They were all light in colour. The scales were pale brown. The general colour appeared to be largely due to underlying organs which could be seen through the skin to move backwards and forwards with each inspiration and expiration.

Smith mentions that Annandale's var. *arenicola* "are pale buff in colour" and "were found in sandy desert country". These specimens also lived in sand, so perhaps the light colour is adaptive.

Boidae.

Eryx conicus.

11 specimens were examined 6 ♂ and 5 ♀.

The largest ♂ was 480 total length (b.445 t.35); these are the same measurements as given in the *F.B.I.* No full grown ♀ was obtained, the largest was 487 total length (b.455 t.32). The ♂ showed a range of tail length from 6½% to 8% of total length, the ♀ from 5¾% to 6¾%. In both sexes the smallest specimen had the proportionately shortest tail.

As regards head shields there were no aberrations. Scales across forehead 8-10, mostly 9, 1 sp. 10. Scales round eye 10-13; 1 sp., single eye 10; 1 sp., single eye 13; the two sides different 5 spp. Supralabials 11-15; single side 11; single side 15. Maximum number of scale rows 42-52.

V 158-175. 2 spp. ♀ 158, ♂ 160 outside *F.B.I.* range. C 16-20. Anal always small between two smaller shields, the last ventral nearly always divided likewise into 3. 1 sp. 3rd subcaudal small, enclosed by 2nd and 4th.

Colour varied from brown to light sandy; band down back broken into islands, always a darker brown, and sometimes reddish, sometimes edged with even deeper brown, wholly or partially edged with whitish or light sandy yellow.

This snake appeared to be fairly common, all the specimens obtained were found by men digging in the course of road construction work.

Eryx johni.

7 specimens were examined 2 ♂ and 5 ♀. The largest specimens of both sexes exceeded the *F.B.I.* maxima by a small amount, ♂ 895 total length (b.788 t.107), ♀ 1075 total length

(b.980 t.95). In the 2 ♂ the tails were 12% and 14% of total length, in the 5 ♀ from 9% to 12% of total length.

As regards head shields there was little departure from the normal condition described in the *F.B.I.* Scales across forehead 6 or 7. Scales round eye 9-12 (*F.B.I.* 10 or 11) 1 sp. 9; 1 sp. single eye 12. Supralabials 11 or 12.

V 200-211, C 30-38. Last 1 or 2 ventrals and anal always small between pair of small scales, the sets of 3 having same width as normal ventrals.

Colour of young quite distinctive. Salmon pink on back with indistinct dark cross bands which become distinct and black on tail. The cross bars first fade on anterior half of body. Belly spotted salmon pink and brown.

With increase in size the salmon pink scales become edged with brown and eventually the whole back and belly is earthy brown with no trace of cross bars. Subcaudally it remains white and may also so remain ventrolaterally, although some spp. were brown all round. Scars sometimes showed a little pink.

The tails of all the large specimens were scarred as though they had been bitten. The idea suggested itself that the tail serves to receive attacks intended for the head, which it resembles at first sight.

It appeared to be fairly common. All the specimens were found in the same circumstances as *E. conicus*.

It was very docile, no specimen ever attempted to bite. The only occasion on which one was observed to move rapidly was when taking a rat.

The discovery of this species was a surprise for the nearest locality mentioned by Smith is Lucknow (about 675 miles from Cocanada). Smith quotes Russell's statement that "It is not uncommon in Bengal" and adds that "the regions to which he refers are well outside the area which it now inhabits".

Colubridae.

Ptyas mucosus.

18 specimens were examined, 8 ♂ and 9 ♀. The largest ♂ was 1955 total length (b.1420 t.535). The largest ♀ was 1845 total length (b.1322 t.523). In the ♂ ♂ the tail length varied from 26% to 28% of the total length, in the ♀ ♀ from 25½% to 30%.

Head shields; 1 sp. single loreal; 1 sp. 2 loreals, remainder 3 loreals; 1 sp. left prefrontal divided giving appearance of 4 loreals; 2 spp. lower left hand loreal met eye, in one also upper left temporal vertically divided. All other spp. temporals 2+2.

V ♂ 194-202 ♀ 196-203, C ♂ 117-124, ♀ 106-124.

The individual ventral counts were:—

♂ ...	194	195	...	197 197	198	199	200		202	
♀ ...	...	...	196	197	198 198	199	200	201		203

This gives the ♀ a little higher average.

The vertebrals were all slightly enlarged.

As regards scale rows there was generally a ring of 23, a few rings of 21, about a dozen of 19, 17 to about mid-body, a short length of 16, a ring or two of 15 and the remainder 14. The 17 to 16 reduction was effected by the fusion of the vertebral row with one adjacent. In one specimen there was a drop from 17 to 15 to 14. The 15 to 14 reduction being by fusion of the vertebral row with the row adjacent. Another specimen dropped 17, 16, 15 a long stretch of 13, 2 rings of 12, 2 rings of 13 and 3 rings of 14. The point of fusion of the vertebral row with the row adjacent may evidently move.

The colour varied from light sandy yellow to such a dark colour that the bands could scarcely be distinguished. The belly was generally yellow.

From a ♀ 1695 total length (b.1260 t.435+) 8 eggs were taken on January 25th. They measured 53 × 15—56 × 18. No embryos were visible. This snake was common.

Ahaetulla tristis.

8 specimens were examined, 4 ♂ and 4 ♀. The largest ♂ was 910 total length (b.605 t.305) the largest ♀ 1180 (b.855 t.325).

The head shields were normal with a few minor exceptions. 1 sp. small scale between anterior temporals, lower postocular and supralabials 6 and 7. 1 sp. small scale between 4 temporals on left hand side. 1 sp. supralabials 5 and 6 united.

Contrary to the list of common characters for the genus given in the *F.B.I.* the enlarged vertebral scales did not originate by the fusion of two rows on the neck. There was a single vertebral row straight back from the parietals.

V 183-188 (6 spp.) C 134-140 (4 spp.)

Scale rows generally a few rings of 17, about half the body length of 15, a few rings of 13, and the remainder 11. One ♀, V188, had the last 45 rings 9. In another ♀ V188, the last 7 rings numbered 11, 10, 9, 11, 11, 11, 11.

The colour was purplish brown above, a pale yellowish below. The black temporal stripe was not conspicuous, vertebral scales on the neck pale yellow, a median spot of the same colour on the parietals.

This snake appeared to be fairly common.

Natrix piscator.

20 grown specimens were examined and two batches of hatchlings, one of 13 and one of 17. The largest ♂ measured 880 total length (b.600, t.280) and the largest ♀ 1030 (b.770, t.260). The tail length of ♀ ♀ varied from 23% to 37% of the total length and from 29½% to 42% in the ♂ ♂. In the matter of scale characters the second batch of hatchlings, 17, showed so many irregularities that they will be described separately.

Head shields. Temporals 2+2, 16 spp.; 2+3, 5 spp.; 2+2 and 3+3, 1 sp.; 2+2 and 3+2, 1 sp., the last two both owing to division of a 1st upper temporal. 4 infralabials in contact with the anterior genial on one side, 3 spp.; left infralabials 8 and 9 united, right 9 and 10 united, 1 sp.; 2 postoculars, 1 sp.; 2 postoculars one side only, 1 sp.; 4 postoculars one side only, 1 sp.

1 specimen had very abnormal head shields. On the right supralabials 3-8 were fused with one another, and the lower postocular was fused with the lower temporal and supralabials 6 and 7. The left infralabials had a small cuneiform scale between the 3rd and 4th.

There was a distinct difference in the ventral counts of the sexes.

♂ V 134-141	♀ V 146-156

In the case of the first batch of hatchlings there was a difference in the subcaudal counts also.

♂ V 136-139	C 89-93 (5 spp.)
♀ V 146-152	C 76-83 (8 spp.)

There were a few irregularities of the ventral scales. 1st V divided, 2 spp.; 2nd V divided, 1 sp.; 2nd and last V divided, 1 sp. V 132, 133 and 135 divided 1 sp.; last V broken up and some parts fused with adjacent shields, 1 sp.

As regards scale rows there was generally a ring of 25, a few rings of 21, a long stretch of 19 to past mid-body, 17 to anus.

The colouration was rather variable. The subocular and postocular streaks were always present, sometimes the postocular one continued past the corner of the mouth. The two parietal spots were always present except in one specimen with the left-hand one missing. The majority of specimens had 7 rows of spots, some 6 and a smaller number 6 on the neck and 7 on the body. The general ground colour was olive with a different colour between the spots which ranged from whitish, grey, sepia, brown, greenish yellow to red or pink, and which sometimes displaced the olive colour from the body.

As regards colouration of the hatchlings all had 6 rows of black spots.

The first batch fell into 2 groups in the matter of a number of colour characters. Group *A*, 1 ♂, 7 ♀; group *B* 4 ♂ 1 ♀. Head, *A* dark olive, *B* light olive; back, *A* olive, *B* yellow green; 2 parietal spots and a spot on the occiput, *A* white, *B* yellow; on each side behind each set of 3 black spots, *A* 2 red spots, *B* 2 pale red spots. This appears to be a case of partial sex-linkage of genes having a general effect on development of pigments.

The distribution of other colour characters in the two batches suggested that the following are genetically determined: presence or absence of: a black ring round parietal and occipital spots—dark stripes on sides of neck—dark band across occiput—yellow patches on sides of neck—yellow belly—small light spot above upper black spot on each side.

On February 11th, one snake laid 19 eggs during the night, they hatched out in from 51-52½ days. On February 16th, another snake laid 31 eggs during the night, they hatched out in from 37 to 38 days.

The eggs measured 27 × 17—25 × 15 mm. When laid they contained fairly well advanced embryos.

The hatchlings measured 154-195 total length.

The second batch of hatchlings showed many irregularities.

The internasals were divided obliquely, 2 spp., incompletely divided obliquely 2 spp. Temporals 2+2, 15 spp.; 2+3, 1 sp.; 2+1, 1 sp. 4 infralabials meet anterior genials, 14 spp. 2 postoculars 1 sp.; on one side only 1 sp. Supralabials 8, 1 sp.; 8 on one side 2 spp. in one of these 5th divided giving appearance of subocular.

V ♂ 132-142 (13 spp.) ♀ 145-147 (4 spp.) C 71-84.

There were a great many irregularities of the ventrals. The irregularities consisted of, divided ventrals, intercalated shields half normal width, enlargement of one shield at the expense of its neighbours and intercalation of small scales between others. Only 3 spp. were quite normal.

The ventrals of which irregularities occur are tabulated opposite. X indicates an irregularity. Some of the tails also showed irregularities, consisting in that the shields were in opposite pairs instead of alternately, or a series of cuneiform scales between the normal ones. In 4 spp. the following stretches were irregular 1-5, 16-25, 64-70, 75-80 respectively.

The umbilical scar covered 3 ventral shields and varied in position from 99-101 in a sp. V 132 to 128-130 in a sp. V 146.

Unfortunately it was not known which ♀ laid the eggs, consequently not so much genetical information can be deduced from the batches as might have been the case.

The differences in the subcaudal counts of the sexes in the first batch may be due to sex-limited differences in tail length or, perhaps, to the fact that a well marked sexual difference in ventral counts would give an incidental difference in subcaudal counts if there were no great variation in total vertebral number. Asymmetry of shields may be due to coiling of embryos exerting a mechanical effect on development.

Natrix stolata.

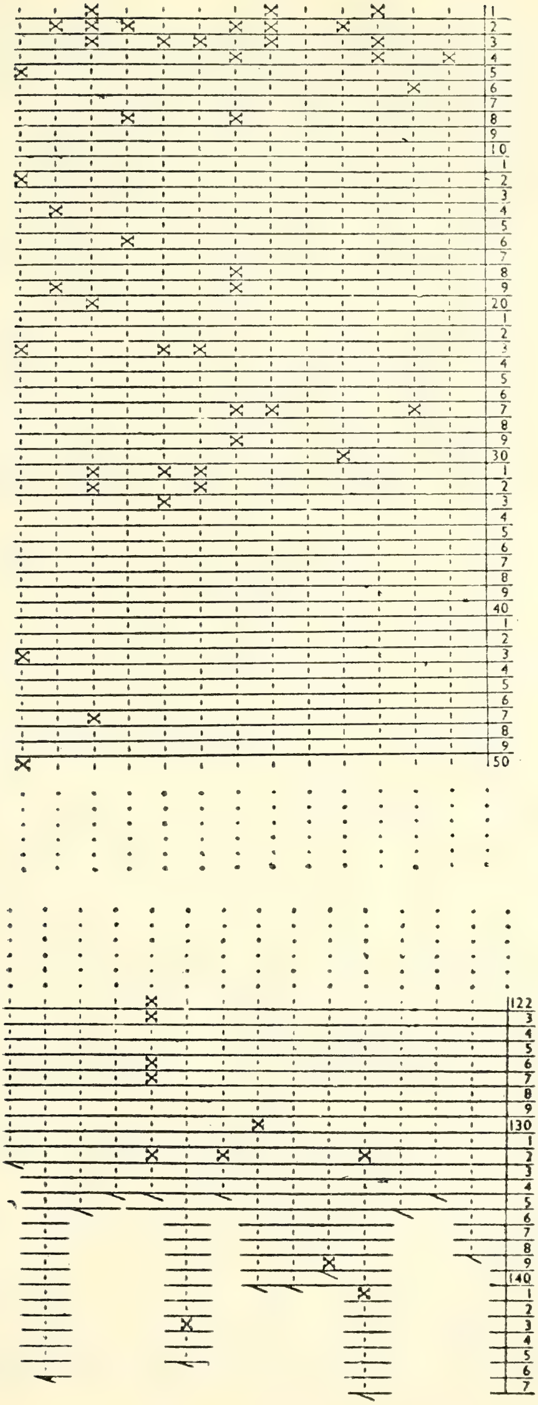
9 specimens were examined. The largest ♂ was 495 total length (b.361, t.134) the largest ♀ 502 total length (b.379, t.213).

There were many irregularities of the head shields. 3rd and 4th supralabials fused on one side, 1 sp.; 7 supralabials, 2 spp., on one side only 1 sp., in which 3rd and 4th meet eye; 4th and 5th supralabials only met eye 1 sp.; 4 infralabials met anterior genial, 1 sp.; 6 infralabials on one side met anterior genial, 1 sp.; temporals 1+2, 3 spp.; 1+1+3, 2 spp.; 1+2 upper shield divided 1 sp.; 1+3 upper shield divided, 1 sp.

V 143-151 C 67-90.

1st V divided and half shield between V's 145 & 146, 1 sp.

The colouration was fairly constant. Olive greenish above with black cross bands intersected by longitudinal buff stripes, at the intersections white spots, these are more pronounced and black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Irregularities in ventrals of *Natrix piscator*.

bands less pronounced on the neck. Sides of ventral shields normally have scattered small black spots. Top of head olive, shields sometimes edged with black. Lips pre- and post-oculars and sides of neck usually yellow, sometimes all yellow is absent.

Five specimens were caught within a few yards of one another outside the cook house. When they were brought to the writer 4 were dead and 1 alive. When they were examined it was found that the live ♂ was copulating with a dead ♀. It resented attempts to separate them.

8 eggs were laid on February 1st, they hatched in 41 days. They measured 24 × 12—21 × 11.

Atretium schistosum.

15 specimens were examined, 14 ♀ and 1 ♂. The largest ♀ measured 845 total length (b.677, t.163 + broken). This is larger than the *F.B.I.* record of 800 total length (b.615, t.185).

The head shields were variable. 3 postoculars 6 spp.; 3 and 2, 3 spp.; 2, 4 spp. Supraoculars divided giving appearance of 2 preoculars 2 spp. Temporals 2 + 2, 8 spp.; 2 + 3 and 2 + 2, 3 spp.; 2 + 3, 1 sp.; 2 + 2 and 2 + 1, 1 sp.; 2 + 2 and 2 + 1 (upper temporal fused with parietal) 1 sp.; 2 + 2 and 3 + 1, 1 sp. Supralabials 9, 12 spp.; 8 on left 3rd and 4th meet eye, 10 on right 5th and 6th meet eye, 1 sp. Infralabials 5 meet anterior genials, 8 spp.; 4 meet them, 3 spp.

V ♂ 144 (1 sp.) ♀ 150-159 (14 spp.) C 66-71 (5 spp.)

10 out of 15 tails were docked.

The scale rows generally ran 1 ring of 23, 1 or 2 of 21, 19 to mid-body, 17 to anus.

The colouration was generally olive. 2 spp. were slaty grey with grey eyes. There was generally a dark line on the back on rows 7 and 8. A dark streak runs back from the eye on to rows 3 and 4 on the neck, sometimes followed by another streak on rows 2 and 3. A dark lateral streak between rows 1 and 2 from the middle of the body back was sometimes present. Most showed a light lateral line on row 3. A red line down the side on rows 4 and 5 present in 2 spp. The lips and under surfaces yellow.

One specimen, body 498, contained 5 eggs in one oviduct 7 in the other on December 26th.

Two specimens (bodies 633 and 677) laid 76 eggs between them in one night on January 15th. One specimen (body 677) laid 24 eggs January 30th.

The eggs measured 23 × 18—21 × 15. No embryo was visible. Unfortunately all the eggs became addled before hatching but one contained a nearly finished embryo after 78 days.

In the stomachs of 2 specimens crabs were found. Not one was observed to eat frogs in captivity. This snake was very common in the paddy fields.

Lycodon travancoricus.

This snake did not appear to be common. Only four specimens were obtained, all were aberrant, 3 ♂ and 1 ♀. Owing to the aberrations the specimens will be described separately, lettered *A, B, C,* (3♂) and *D* (♀).

In all 4 the anterior nasal is larger than the posterior (*F.B.I.* 'subequal'). *A, B* and *C* have anal divided (*F.B.I.* 'anal single') *D* anal single. *A* loreals just fail to meet, *C* and *D* loreals are in good contact with the internasals. Temporals *A* 2+3 and 3+3, *B* 2+3, *C* 2+4, *D* 2+3.

A,V 188 C 70; *B*,V 164 C 67; *C*,V 180 C 67; *D*,V 183 C 49

The colouration agreed fairly well in the specimens. Ground colour purplish brown; 20-23 yellow bands on back two rings wide, shrink and become spots towards anus. Each yellow scale spotted with dark brown. 8-10 dorsal spots on tail, the last few were just distinguishable yellow marks. Head purplish brown above. Upper lips yellowish, first 7 or 8 supralabials have brown centres diminishing to a spot on the 8th. From the 6th and 7th backwards a dark brown band crosses the upper half of each labial. The yellow on the lips runs back as a speckled yellow band to join the first transverse band. Scale row 1 edged with yellow some scales in other rows edged yellow forming triangular expansions of cross bands.

Lycodon striatus.

Only 3 specimens were obtained.

V 152, 165 and 172. The count of 172 exceeds that given in the *F.B.I.* for south of 20° North. C 42, 46 and 41 respectively.

The head shields were all normal, all the specimens had temporals 2+3.

The 3 spp. agreed closely in colour. They were pure black with white spots on the back. The centres of the white spots were yellow on vertebral and adjacent rows on anterior half of body, the white spots expand laterally as white flecked triangles. There was no bar on the nape.

Dryophis nasutus.

3 specimens were examined.

Temporals variable, 2+2, 1 sp.; 1+3 and 1+2, 1 sp.; 3+2 first upper divided, 1 sp. Presuboculars 2, 1 sp.; 1, 2 spp.

In the *F.B.I.* 15:15:13 rows are given as a common character for the genus. 2 spp. had 13 rows followed by 28 rings of 11, followed in 1 sp. by 11 rings of 10, in the other by 44 rings of 10.

V 180, 197 199 C 146, 170 154.

The colour was consistent for these and other specimens.

Verdant green above, oblique black and white stripes on interstitial skin of anterior half of neck, pale green below, yellow line along keeled edge of ventrals. Lips yellow or yellowish.

Boiga trigonata.

Several specimens were seen but none were examined. It appeared to be moderately common.

Cerberus rhynchops.

3 specimens were examined. The larger ♀ was 913 total length (b.778, t.145+broken) the ♂ was 768 (b.612, t.156).

There were 3 suboculars and 9 supralabials, the last 3 horizontally divided.

V♀ 145, 143 ♂ 150 C♀ (broken), 55 ♂ 63.

The scale rows ran 25, 23, 21, 19, 17.

The colour was dirty olive above with black bands on belly. Dark bands on back were only just perceptible.

On August 14 a specimen gave birth to young, which escaped from a cage not constructed to hold them. Three were recovered, they were coloured as follows: olive above, black cross-bars, anterior few not full width, others irregular and mixed with some black spots; black streak through eye onto side of neck; lips and belly white, black transverse bands on belly merging to form a more or less distinct median line down belly.

This snake was fairly common in the Godavari estuary.

Elapidae.

Naja naja.

The local people said that the cobra is found in the district but that it is not killed because it is held as sacred. This is probably why no specimens were obtained.

Bungarus caeruleus.

There is a specimen obtained locally in Pittapur Raja's College. However all the "kātlā pāmbu" (Telugu name for krait) brought by the villagers were Lycodons.

Viperidae.

Vipera russelli.

3 specimens were examined. The largest was 1178 total length (b.975, t. 203).

Round eye 12 or 13 scales, across tip of snout 2 or 3 scales, between supraoculars 7 scales, supralabials 10 or 11, 3 rows between them and eye.

In the middle part of the body were small scattered spots between the large dorsal and lateral markings, below the lateral markings were irregular brown marks on rows 1 to 3. There were numerous semilunar spots on the ventral shields of the anterior half of the body.

FIELD NOTES ON THE MAMMALS OF SOUTH TINNEVELLY, SOUTH INDIA.

BY

C. G. WEBB-PEPLOE.

(*With one plate.*)

Tinnevelly is the most southerly district in the Madras Presidency. It is bounded on the east and south-east by the sea, on the west and south-west by the Western Ghats and Travancore State, and on the north by the plain of the Ramnad District. Through the centre of the district from west to east runs the Tampraparni River. There are a few lowish hills here and there in the plain but for the most part it is entirely level.

The following notes have been written from observations recorded during the past twenty years, chiefly in an area in the south of the district near the small village of Dohnavur (thirty miles from the sea to east and south, and two miles from the foot of the Western Ghats), and in the forest round an estate in the adjacent mountains, nine miles away, called Naraikkadu.

The country round Dohnavur is composed of comparatively unfertile sandy land covered with palmyra palms, interspersed with large channel-fed irrigation tanks and their attendant paddy-lands. The average rainfall is about 35 inches, and this decreases as you move eastwards.

The estate of Naraikkadu is set in evergreen forest at a height of 2500-3000 feet. On both sides of the valley mountains rise to well over 5000 feet. On the tablelands above are large areas of grass with the clearly-defined strobilanthes-bordered sholas, typical of the South Indian mountains. The slope of the hills is very steep, rising more or less straight up from the plains. The rainfall in this estate averages 115 inches a year, and it is probably considerably more on the mountain tops. Between these two biotopes is a fairly narrow strip of foothills where the cultivated lands give way to low grass-covered hills with single deciduous trees standing here and there, except in the water courses which are more thickly clad.

In the community centred in Dohnavur there are many keen students of natural history, and boys and girls in our schools grow up to love all wild life and to protect it. Some of them have become reliable observers, and to them I owe much in the compiling of the details of these notes.

PRIMATES.

1. **Lion-tailed Monkey.** *Macaca silenus.* Tam. *Arakkan.*

Found in evergreen forest, local, but not uncommon. Seen in troops of about twenty. They make a kind of subdued grunt, and also a sound like a loud pigeon's 'Coo'. Small babies (seen regularly in September) have a high-pitched squeal. These monkeys move about the forest in a much more leisurely way than the Brown Monkey or the Nilgiri Langur. Though quite capable of leaping from tree to tree we have noticed that they prefer to climb slowly along the branches, often standing motionless rather than sitting down when they stop. They are more nervous and shy of man than the other two species, though both these will keep out of the way when the Lion-tailed Monkey is about. Once several were seen climbing slowly down one tree and walking along the ground to the next tree. This they climbed, investigated and came down to earth to repeat the process all in their usual deliberate way.

2. **Bonnet Macaque** *Macaca radiata.* Tam. *Kurangu.*

Common in evergreen forest and also found, semi-domesticated, by some Hindu temples and in certain well-wooded villages on the plains. They are seen at times on rocky upper mountain slopes and do not seem to object to the ground as much as Nos 1 and 3. They prefer trees, however, travelling in large parties, and are very active. They are inquisitive, and if there is something in the forest which they do not understand they will come closer and closer to find out about it. One mother was observed with *two* very small babies clinging to her. How they managed when older it is difficult to imagine. We once kept one of these monkeys as a pet, but their temper is unreliable, and they are not very satisfactory where children are about.

3. **Nilgiri Langur.** *Kasi johnii.* Tam. *Karu-manthi.*

The commonest of the three monkeys in our evergreen forests, ranging from about 2000 feet to the tops of the mountains wherever there is *shola.* They travel in family parties of twenty to thirty. Their 'whooping' cry carries a long way and is often heard. They are bold, and quite often will run along the roof of a house and leap off onto a tree at the far end if it is the shortest route to their destination. Their acrobatic jumps are marvellous and they seldom seem to look before they leap. In spite of this only twice have we seen them fall to the ground, and they soon recovered and were up and away again. They have a strange way of rushing headlong through the trees and then suddenly they stop, sit down, pick a few leaves and begin to eat as if they had never been moving at all, reminding one of the children's game of 'steps'. A troop spends the night in trees near one of our houses and sometimes the angry 'barking' alarm note is heard which presumably means one of the larger cats is passing below. Once we went to investigate and by the light of a torch saw three monkeys on the topmost climbable branches of the tree, far above where they usually sleep. They made no noise however because of our torch, for I suppose they knew that the greater danger had passed. Quite small young have been seen both in June and September. On one occasion in June I found a very sick mother monkey on a large rock in the river bed. Its tiny baby lost its hold of the mother and slid half way down the rock to a ledge. The mother was too ill to reach it (she died next day), so I went very slowly towards it, so as not unduly to disturb the large monkey, picked the baby up and took it home. It drank milk from a teaspoon and slept on its side, with its head bent back at a rightangle, in a small basket. Next day a large Nilgiri Langur was in a tree nearby, so we put the baby low down on a branch and very soon the big one came down and carried it away to safety.

About a hundred yards in front of one of our forest houses is a 'monkey bridge,' part of a regular road through the trees used by monkeys and the forest squirrels. It is in full view of our front verandah, and frequently they will pause for a rest on it. Occasionally two kinds will meet on the bridge. The Bonnet Monkey and Nilgiri Langur pass peacefully and go their ways, but both disappear when the Lion-tailed Monkey is in the vicinity.

4. **Grey Langur.** *Semnopithecus entellus.* Tam. *Vellai manthi.*

Fairly common along the foothills on rocky spurs that jut out into the plains and among the great rock faces that lie amidst scrub-jungle below the evergreen belt. A troop of forty to fifty was seen recently. When jumping they hold the tail straight out behind with a slight curve up at the end. Though they prefer rocks, unscalable to anything but themselves, they can take to trees if need be. Their cry is quite distinct from the other three monkeys, nearest to that of the Nilgiri Langur in tone.

5. **Slender Loris.** *Loris tardigradus.* Tam. *Thēvangu.*

Not uncommon, but seldom seen as it is nocturnal. Its cry is almost human, like a baby crying. It has been found in evergreen forest at 2500 feet, and one was found near sea-level in scrub-jungle on top of an *Acacia planifrons.* We have kept several as pets. They were fed chiefly on grasshoppers and other insects.

CATS.

6. **Tiger.** *Panthera tigris.* Tam. *Puli* (in books), *Kaduvāy* (colloquially).

Occasionally seen, and its pug-marks are often met with, from the foothills upwards. On June 13 last one was met on the main path below our forest house in broad daylight. It was neither angry nor afraid, and quietly faded into the jungle. But it no doubt prefers to move by night. It does very little damage to the local cattle, probably due to the abundance of sambar in the forests. After writing this last sentence, however, I hear that a tiger a few days ago killed one of the scrub cattle which are driven out daily to graze at the foothills. It was seen by one of our men just beside the forest boundary which adjoins a piece of land belonging to us at the foot of the mountains. Twice in the past thirty years a tiger has wandered out onto the plains, in one case it walked through our compound at night. On December 15, 1942, some men were sheltering from heavy rain in a small hut at the foot of the hills. A sambar doe came past pursued by two tiger cubs about 3 feet long. When the cubs saw the men, they stopped, which enabled the deer to escape. In front of the hut was a long sloping rock on which the two cubs then lay down and washed themselves just like a domestic cat. They next began to play about, and one took a running jump to climb up a palmyra tree but fell off from a considerable height. It didn't, however, hurt itself. None of the men had a gun so the two cubs finally went off unharmed. A small child once met a tiger cub face to face in our forest estate; and on another occasion some of our children saw a mother and cubs playing. We have proved that if we do not harm them they do not harm us.

7. **Leopard.** *Panthera pardus.* Tam. *Sirutthai, Puli* (colloquially).

Though not often seen, its sawing cry has many times been heard from our houses in the forest. Coolies carrying supplies up from the plains have met it on the paths. On 8-3-43 in daylight a pair of half-grown cubs came within a few yards of the house, but soon melted into the forest when someone saw them and called others to come and look.

8. **Jungle Cat.** *Felis chaus.* Tam. *Kāttu poonai.*

Common around and in our compound and in the foothills but not in evergreen jungle. It is very long in the leg and larger than a domestic cat. It brings forth its young on top of the Celotex 'ceiling' that we have in our houses. These have been found in the months of May and November. Four are the most that have been found at one time. It usually leaves the house just after dusk and returns before sunrise. A mother cat once tried to retrieve her young one that was sleeping on the floor beside a boy who was keeping it. She gave everyone a good fright but failed to get it back. Though it grew up a most attractive pet and was comparatively tame, it was always roused to fury by a sandalled-foot; for what reason I do not know. It would spit and strike sideways at it with its right front paw. This jungle kitten when nearly full-grown was taken to the forest and turned loose, as, in those days, we thought mistakenly that they lived there, but within a few weeks it found its way back to our compound to the one whose pet it was.

Another wild kitten that was very thin and sickly (perhaps it had lost its mother) gradually became friendly but never wholly lost its wild ways. One day it had a fight with a toy dog, and another time, objecting to a toy Koala Bear it removed it someway down the road. It finally became a nuisance and had to be transported to some foothills nearby, from which it did not return.

9. **Leopard Cat.** *Prionailurus bengalensis.*

I have never seen this and am not certain whether it is found in our forests or not.

10. **Rusty Spotted Cat.** *Prionailurus rubiginosa.*

This is considerably smaller than the Jungle Cat, and has clearer markings on the head. One frequented a house, set in low foothills and surrounded by scrub jungle, in which some of our children live. It was often seen going in and out of the roof. It is a lonely place with no other houses near.

CIVETS.

11. Large Malabar Civet. *Moschothera civettina.*

This also is doubtful, though it is very likely to be found on the mountains as most of our fauna conform to that on the Travancore side.

12. Small Indian Civet. *Viverricula indica.* Tam. *Punuhu.*

It is common in the evergreen forest at 2500 feet and is found also in the foothills deciduous area. As it is nocturnal it is not often seen, but its droppings are found everywhere on rocks and forest paths. It is very partial to the fruit of Caryota urens (Kitul palm).

13. Indian Palm Civet. *Paradoxurus hermaphroditus.* Tam. *Mara Nāy.*

It lives in the roofs of houses on the plains and goes out at night. I saw one in the middle of the night recently, by the entrance to one of our pigeon cotes. The small door into the cote was shut but it was standing on the landing step used by the pigeons. Its long bushy tail hung straight down. I was able to get a very close view of it by the light of a torch. Only when we tried to touch it did it jump down and run away. Another, which had entered a pigeon-cote and killed some pigeons, was shot on the night of 24-11-46. It eats fruit and is very fond of banyan fruit. Men who hunt them find them by watching banyan trees in full fruit. It also takes small birds, though its main diet is vegetarian.

14. Brown Palm Civet. *Paradoxurus jerdoni.* Tam. *Mara Nāy.*

The forest equivalent of the last. It is more grizzled in colour than the plains' Palm Civet. On 24-9-41 one was seen on the branch of a tall forest tree. It allowed many of us to come and see it most clearly, as it lay resting its head on its two front paws stretched out along a horizontal branch. It looked down at us quite unafraid, remaining in this position for the best part of half an hour. Only when a man had climbed half way up the tree did it rise and move on. It swarmed up the perpendicular trunk like a cat, walked to the utmost extremity of a branch and slowly reached out to a branch in the next tree while holding on with its back legs to the first tree. It was later seen several times eating the fruit of *Fragraea obovata* in a ravine near one of our houses. This Palm Civet brings forth its young, usually two, in hollow trees. A young one of about two months old was found dead on a forest path on 1-10-46.

MUNGOOSES.

15. Common Indian Mongoose. *Herpestes edwardsii.* Tam. *Keeri pillai.*

Common everywhere in and around our compound and at the foothills. They live in holes in the ground under our firewood store, and their young, usually two though sometimes as many as four, have been found in the roofs of houses and in empty boxes in our wood store. They come out about half an hour before dusk and are mostly nocturnal, though they are not infrequently seen in the daytime when the compound is quiet. On moonlight nights family parties have been seen out foraging, moving along in single file head to tail. They have a way of suddenly stopping, and sitting up on their hind legs to survey the scene, which is most engaging. We have often kept them as pets. They are very clean. They have a strange habit of trying to run in and out between your feet as you walk along, which makes progress rather slow! They eat rats and mice, as well as snakes and lizards, and sometimes will even catch a hare.

16. Long-tailed Mongoose. *Herpestes smithii.*

This has the tip of the tail jet black whereas the Common Mongoose has it ochre-coloured. I have only once seen it, in rocky foothills type of country, and its range extends up the hills into the evergreen belt.

17. Nilgiri Brown Mongoose. *Herpestes fuscus.*

Common in our evergreen forest at 2500′. Seen moving about in the daytime. It comes regularly to the kitchen after dark for bones from the rubbish pit. I had a splendid view of it one night in September 1945. It was lying in a tangle of low bushes beside a bare slope below the kitchen. A round hole showed its way in and out. As I was waiting in the moonlight it came out. I turned on the torch, at which it looked and sniffed for a moment, then, quite unperturbed, it went on foraging round on the open slope only a few feet from where I was standing. I watched it in this way for several minutes. It was of a very dark brown colour and as it moved in the light there appeared a dark chestnut tinge about it.

18. Stripe-necked Mongoose. *Herpestes vitticollis.*

One was killed by a dog on an estate about twenty miles north of us. The chestnut coat and black streaks on the neck make the identification easy. It is the largest of the four mongooses and its habitat is evergreen forest up to the tops of the mountains.

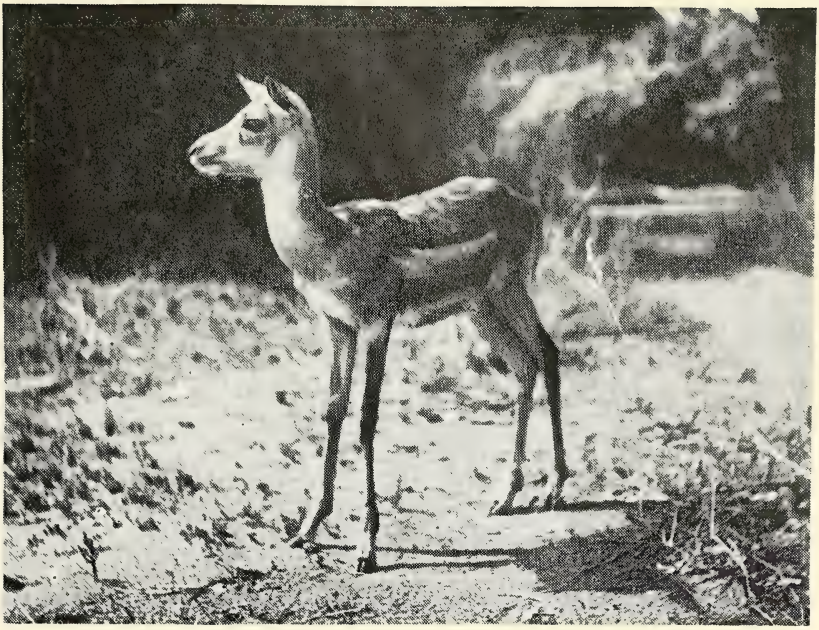
19. Indian Marten. *Charronia gwatkinsi.*

An animal which almost certainly must be this has several times been seen clearly in trees in the sholas at the top of the mountains at about 5000 feet.

DOG TRIBE.

20. Asiatic Jackal. *Canis aureus* Tam. *Nari.*

Common throughout the plains and foothills. Lies up in cover during the day and roams about at night. In February 1946 a litter of five cubs was found on the top of the mud-wall bordering a betel-vine grove two miles north of our compound. One of our young men who went to see them heard the mother bark as she



1. Blackbuck (*Antilope cervicapra*) 4 months old. The colour line where later the black of the upper parts and the lighter colour of the lower parts divide is clearly seen.

2. Indian Fox (*Vulpes bengalensis.*)

ran off, but did not see her. The cubs were lying in a small depression on the mud bund up against the fence of plantain leaves which surrounds such groves in paddy land. The cubs were only eight days old. The mother carries them from place to place in her mouth if there is danger of their being disturbed, for the place in which they were then found was not where they had originally been born. One cub was brought back and fed on milk for about five weeks. Its eyes had opened and it was becoming very interesting, but a too early change in its diet disagreed with it and it died.

21. Indian Wild Dog. *Cuon alpinus.* Tam. *Sen Nāy.*

Fairly common both in deciduous and evergreen forest. On many occasions they have been seen by day. On 10-9-40 a large party of our boys went for a picnic to a river pool in the foothills. Just after mid-day one of them heard the sound of dogs quarrelling and barking. When he went to investigate he found a pack of Red Dog with a freshly killed sambar. Not having seen Red Dog before he at first mistook them for pariah dogs, but their uniform red colour and high-pitched barking made him realize what they were. When he clapped his hands they ran away, but, while he went to call others to come and see, they returned and when the other boys arrived there were twelve dogs busy eating. The sambar had fallen in a small pool in the riverbed. They had by this time eaten its stomach and one shoulder, but as many people were coming to look at them the dogs disappeared. At intervals during their feed they plunged into the water, apparently as much to cool themselves as to drink. Another of our keen naturalists has seen a mother dog teaching her young ones to strike at a sambar fawn which was standing at bay in a river pool.

22. Indian Fox. *Vulpes bengalensis.* Tam. *Kulla Nari.*

This is fairly common on low rocky hills that jut out into the plain as spurs of the main mountain chain, also on isolated hills of the same kind right out in the plains. It lives in holes in the rocks, is nocturnal and very difficult to catch. We sometimes see them in the headlights of the car on roads that run near these hills, for they come down by night into the cultivated fields and paddy land. They feed on lizards, frogs, crabs and such small fry. On March 8, 1943 a full-grown vixen was brought to us. Some gypsies had caught it, sewn up its eyelids and lips with horsehair and tied its feet, toe by toe, tightly with wire. They were hawking it for sale for medicine. We bought the poor suffering beast, untied it and kept it in peace till it died of its injuries. Two days later we obtained a two months old cub. It was most ferocious and for months would bite right through the skin if mishandled or frightened. Very gradually it responded to loving, careful treatment. It is now still with us, a most delightful pet. It shows a real affection for the one or two who specially look after it. If it hears their voice or sees them coming it will lie flat with its ears along its back uttering little cries of joy. It goes for a daily run, free, every morning. In the rainy weather when the grass in our compound is long, to see it gracefully bounding over obstructions or running flat out for a short distance as if pursuing something, is a beautiful sight. When called to come back to its large cage it sometimes behaves like a spoilt child lying down and whining, refusing to obey. We removed six tiles from the floor of the cage (a small room about 8′ × 8′), and it soon dug a burrow, but the trouble was that it burrowed right under the stone foundations and came out the other side and escaped. This was soon discovered and it was found again without difficulty, but we had to block up the burrow. It is fed on milk, plantains, rice, and occasionally meat in the form of chickens' entrails. Once or twice we gave it an egg which it picked up in its mouth without cracking the shell and carried underground. Later it made a hole at one end and licked all the contents out holding the shell with one paw. It loves to bask in the afternoon sun. It has remained in the best of condition as the accompanying photograph shows and now allows itself to be handled freely, though its first reaction to anything new is a nervousness which makes it run away to hide. It plays with our dogs and is quite unafraid of them. The story of certain foxes having a small 'horn' on the crown of the head under the skin is a complete myth. The gypsies know how widespread is this belief and trade on it, charging Rs. 2 for a tiny piece of bone said to be this 'horn'.

OTTERS.

23. **Clawless Otter.** *Amblyonyx cinerea.* Tam. *Neer Nāy* or *Meen Nāy.*

This lives in the stream which runs through our small estate. It is seen from time to time and a baby was once found at the end of April. It brings forth its young, usually two, in inaccessible holes in the rocks near the stream. Probably there is a pair in each of the perennial mountain streams. I saw a pair beside a pool quite near our house on the early morning of 9-10-46.

BEARS.

24. **Sloth Bear.** *Melursus ursinus.* Tam. *Karadi.*

Fairly common through both evergreen and deciduous forest, even coming down on to the plains where scrub jungle exists. It is occasionally met by those travelling on forest paths in the early morning or evening. Several men have been brought to our hospital after painful encounters with bears. One of us came across a half-grown one at about 4000 feet in October 1946.

HYAENAS.

25. **Striped Hyaena.** *Hyaena striata.* Tam. *Karuthai Puli.*

One was shot some years ago at the base of a 1600 foothill standing out in the plains a few miles south of us. It had been living in a cave among the rocks and making a nuisance of itself by killing the local sheep. Others have been seen in the forest twenty miles north of us, but it is not at all common in the neighbourhood.

INSECTIVORES.

26. South Indian Hedgehog. *Paraechinus micropus.* Tam. *Mulleli.*

This lives in the same low rocky hills as the Indian Fox. We have kept several as pets. They are nocturnal and sleep rolled up in a ball most of the day. They eat milk and rice (in captivity), and termites and insects. A mother, with two babies only two or three days old, was brought to us on 18-4-44. The babies had long white quills with many shorter dark brown ones in between. Their eyes had not opened. Unfortunately they died. The full grown one was let out in one of our market gardens, but not seen again.

27. Common Musk-Shrew. *Suncus* sp. Tam. *Moonjuru.*

Very common in and about our houses on the plains. Its unpleasant habit of dying inside closed drawers is well-known. I found one once at night chewing the toe of a live frog. The frog's screams attracted my attention. Its chief diet, however, seems to be insects.

BATS.

I cannot speak with certainty about the commonness or scarcity of the different Bats, but will list those I have identified. There are certainly more species in our countryside. The common name in Tamil for all bats is *Vavval.*

28. Flying-Fox. *Pteropus giganteus.*

There used to be a colony of these very large bats living in a cocoanut grove beside a river near the foothills, but owing to persecution by man, they disappeared. No doubt they are found in suitable places in our area.

29. Short-nosed Fruit Bat. *Cynopterus sphinx.*

This is probably the common small fruit-bat which comes in large numbers to feed on the Margosa (*Azadirachta indica*) fruit from June to August. Some have been seen spending the day in dead Palmyra leaves still hanging on the tree, others in the roofs of houses.

30. Ceylon Fruit-Bat. *Roussettus leschenaulti.*

One was found dead, answering in every detail to the description in Ceylon Mammals p. 68. Quite possibly this is fairly common too.

31. dndian Vampire. *Lyroderma lyra.*

Several have been found dead. This bat undoubtedly is responsible for the remains of small birds found in the morning on our verandahs—a wing and some feathers. How they catch these small birds, usually warblers, I do not know. A baby was found on 16-3-45—a hideous naked miniature with a huge head and ears. One kept for a few days ate a pipistrelle that was put in the same cage at night—only the wings were left uneaten. This is fairly common.

32. Sykes's Leaf-nosed Bat. *Hipposideros speoris.*

Spends the day in dark roofs of houses. A mother was found on 13-1-44 with a new-born naked baby which she kept licking as the baby clung to her. This also appears to be fairly common.

33. Ceylon Bi-coloured Leaf-nosed Bat. *Hipposideros atratus.*

Probably pretty common. One caught on 8-6-44 was feeding on a small grasshopper.

34. Common Yellow Bat. *Scotophilus kuhli.*

One was found in daylight on 8-7-44 being attacked by crows. It was rescued and kept all day. In the evening it flew away safely.

35. Indian Pipistrelle. *Pipistrellus abramus.* Tam. *Turinjil.*

Probably common, often found sheltering behind door and window shutters or in Venetian blinds in our houses during the day.

RODENTIA.

36. Palm Squirrel. *Funambulus palmarum* Tam. *Anil.*

Common all over the plains and foothills. It eats anything and does considerable damage. When young it makes a very interesting pet, but when fully grown they are usually a pest. Its nests—balls of grass—are found in trees and on beams and in the roofs of houses.

37. Dusky Squirrel. *Funambulus sublineatus.*

This is like a very dark plains squirrel. It is found up to the summit of the mountains all over the evergreen forest area. It has a much more high-pitched note than its plains cousin, and I have often mistaken it for a bird's note. In sunlight there is a ruddy glow to its back. I have usually seen it not far from the ground on trees. It has a strange habit of foraging with a slowly travelling party of babblers such as Quaker Babblers; wherever they go it goes, low down in the undergrowth.

38. Large Indian Squirrel. *Ratufa maxima.* Tam. *Kāttanil* or *Mara Anil.*

Common in evergreen forest, a most beautiful animal. A typical nest at the top of a tall tree was made of small sticks inside, then twigs cut off with its teeth from the tree, with the leaves nicely fitted together. The entrance hole at the side was 4 inches in diameter leading to a 9 inches round chamber inside. The complete nest was 1½ feet in diameter and looked like a ball of dead leaves. On 4-9-46 a mother and four babies (about a quarter her size but with the same colouring) were seen playing on a rock in forest. They remained there about a quarter of an hour.

39. **Common Grey Flying Squirrel.** *Petaurista philippensis.* Tam. *Paravaikkeeri.*

Very seldom seen, but it lives in the forest round the estate, spending the day in hollow trees and coming out at dusk. It has been found when large trees were felled to build a house, and seen on one or two other occasions. A dead one was found at about 2500′ on 12-2-47.

40. **South Indian Gerbil.** *Tatera indica cuvieri.* Tam. *Velleli.*

They are about 7 inches long with a tail of the same length. The hind foot measures nearly 2 inches from hock to claw, and so these 'Kangaroo-rats' can jump great distances. They are a beautiful fawn colour above and pure white below. They have their burrows under cactus hedges or in any untrodden waste ground that has a little cover. There are many runways and two or three ways out. The nest chamber is lined with grass. Upto six babies have been found. They eat grass-seed and grain of all kinds and store some underground. When eating this they leave the refuse inside the hole. They make charming pets and are scrupulously clean. One we kept as a pet ate grasshoppers and cockroaches, the latter with especial relish. Many of the local people eat them.

41. **Bandicoot.** *Bandicota malabarica.* Tam. *Peruchāli.*

By far the largest of the rats, being a foot long with a tail of 10 inches. It lives underground among buildings, and its runways come up through the floor of storehouses. It is very destructive to stored paddy and other grains. They used to live under an old granary in our compound and are sometimes seen.

42. **Southern Mole-rat.** *Bandicota kok* Tam. *Urumumeli* (colloquially *Virumeli*).

This is a heavily-built rat about 9 inches long with a tail of 6½-7 inches. It is coarse-haired, the hairs being brown, rufous and grey mixed, below it is a paler grey. It has its hole in the bunds of rice fields or at the edge of gardens. Though the runways are more than in the last species, there is only one entrance. When the rat is at home the door is blocked with earth, and often there are several other earth blocks at intervals along the main path. The nest chamber is lined with grass. Only two young have been found at a time. There are sometimes two separate store-rooms, one for present use and one for the future. Large quantities of paddy, whole brinjals and 'lady's fingers' have been found in these store rooms. The chaff and uneaten refuse is carried away and left in a heap some yards from the entrance to the hole, and this guides people who hunt for them, for they too are eaten. The burrows may go as deep as 1½-2 feet underground. Sometimes a side burrow will lead to a tapioca plant nearby and the root is eaten little by little *in situ.* Many of the side burrows lead nowhere and seem to be 'blinds'. This rat makes a peculiar grunting noise when disturbed or caught, from which comes the Tamil name meaning 'grunting rat'.

43. **Common Indian Rat.** *Rattus rattus wroughtoni.* Tam. *Mara Yeli.*

This measures about 8 inches with a tail the same length or a little longer. It is brown above with some coarse hairs, and almost pure white below. It nests and lives in the crown of cocoanut palms and is probably common wherever there are groves of these trees. It has two young at a time. It descends at night and feeds on grains and vegetables. Some people eat this rat.

44. **Common House-Rat.** *Rattus rattus rufescens.* Tam. *Veetteli.*

This is well-known and too common. It is about the same size as the last but grey below. It nests in the roofs of houses both tiled and thatched, and comes down to wander about at night. It eats anything and everything. It does great damage to clothes and is altogether a nuisance. Because of its unclean habits this species is not usually eaten.

45. **Common House Mouse.** *Mus musculus.* Tam. *Veettu Sundeli.*

Length 3 inches with tail as long or longer. Colour above brown, below grey. Nests of this mouse are commonly found in rice-sacks or sacks containing some other grain or cotton seed. It has up to eight young at a time. I kept one for a night in a glass jar. It much enjoyed four flying termites. It sat on its hind quarters and held the termite in its front paws, nibbling away till one was finished, then it caught another and carried on with evident relish. Its usual diet no doubt is small seeds and crumbs of anything edible. When I put some cotton wool into the jar it pulled it to bits and made a kind of roof for itself under which it lay.

46. **Indian Field Mouse.** *Mus booduga.* Tam. *Kāttu Sundeli.*

This is slightly larger than the last but its tail is shorter than the head and body. In colour it is sandy-brown above and white below. It lives in holes in cultivated land or in stack manure pits after the heat has gone out of the decaying matter. Its holes have many passages and several ways in and out. It never burrows deep like the Mole-rat. It has a nest chamber lined with grass, and a separate store-room. It has many young at a time. It eats small grains, grass-seed, and nibbles such things as brinjals growing in our market gardens.

47. **Brown Spiny Mouse.** *Mus platythrix.*

It is larger than the Field Mouse and has a more 'ratty' face and coarser fur. A female was caught and the next day gave birth to several young, but unfortunately the mother and young soon died.

48. **Long-tailed Tree Mouse.** *Vandeluria oleracea.* Tam. *Mara Sundeli.*

It is a beautiful chestnut colour above and pure white below. It measures 3½ inches and the tail is up to 4½ inches, noticeably long. This mouse is an opportunist in the matter of nesting sites. In the roofs of houses or the crown of cocoanut palms, in a bunch of unripe plantain fruit, or a fold in a hanging sack, and even in an empty beehive nests have been found made of grass. Four young seem the usual number. It feeds on grass seeds and the smaller food grains.

All these mice make most engaging pets. A small cage with a section of bamboo and a little cotton wool in it for a dormitory, a revolving tread-wheel, which they seem to love, for exercise, and grass seed for food will keep them quite happy. We have often kept them for our children's interest, and they become very friendly.

9. **Indian Bush-Rat.** *Golunda ellioti.* Tam. *Kunnan.*

This is probably the short-tailed rat which lives in the grass from the foothills upwards. Its runways are found everywhere on ground level among the grass tufts. It has been seen on several occasions but never caught, so I have not been able to examine it. Its nest with young was found once in the foothills, a ball of grass low down in a bush in scrub jungle, but I was only told of it sometime afterwards.

Besides these rats and mice there are two other species found in the mountains:

A rat whose Tamil name is *Kalleli* or Rock Rat. This measures about 8 inches with a longer tail; it is sandy-brown above with occasional black spiny hairs, and pure white below. It is very common all up the mountain side, living among the rocks in forested jungle. Its nests have been found in our forest houses— in an empty water pot or in the corner of a room behind a cupboard after the house had been unoccupied for some months. It also nests in trees in the forest, building a ball of dead leaves or grass. It is found far away from human habitation. I suppose it may possibly be the same as No. 43 above, having adapted itself to forest life.

A mouse is found in the cleared parts of the estate, which covers the entrance to its hole with small pebbles when at home. I have found these holes in the ground beside a path, and one mouse made its home on the verandah of a house where the lime cement at the base of the house wall had worn away. It came out after dark and used sometimes to go through the house, but more often straight off the front verandah into the forest, which is but a few feet from the house. The Tamil name for this is *Kattarikkan.* This may be a variety of the Indian Field Mouse, but it does not seem to be the same in its habits, for No. 46 does not in my experience ever cover its hole with stones, but that may be only through lack of suitable material.

50. **Black-naped Hare.** *Lepus nigricollis.* Tam. *Musal* or *Muyal.*

Very common at the foothills and in our compound, especially in the outlying market gardens where it does some damage to new shoots of certain grain crops. It is hunted in the country round with dogs, and many take refuge on our land where they seem to know they are safe and become comparatively tame. They are sometimes seen by day but usually because they have been disturbed. We have often reared them as pets. Baby hares have been found in all the first four months of the year. When born they have a small patch of white hairs towards the back of the crown, which slowly disappears until at the end of six months it is entirely replaced by ordinary hair. Two is the usual number at a birth.

51. **Porcupine.** *Hystrix leucura.* Tam. *Mullampandri.*

Common in the forest round our gardens where it has its burrow among rocks. It makes great havoc among the growing pineapples and also digs up sweet potato. Its quills are found all over the forest, but, being nocturnal, it is not often seen.

ELEPHANTS.

52. **Indian Elephant.** *Elephas maximus.* Tam. *Yānai.*

Quite often heard or seen on the tablelands at the head of the valley in which our estate lies. It moves across from the west to the southern sholas to feed on *Ochlandra* sp. in September just before the N.E. monsoon begins. Most of our records are between September and January. There are well-worn paths made by the elephants both on the grassy mountain sides and in the sholas. They seem to object to innovations, for the stones of a cairn built to mark the junction of several paths were scattered into the surrounding jungle by them, and their visit of inspection after rain to a newly mended anicut did not at all improve the earth bund. A mother elephant with a baby was reported to be a few miles north near a larger forest anicut in September 1944.

RUMINANTS.

53. **Indian Bison.** *Bos gaurus.* Tam. *Kāttu Mādu.*

This also inhabits the same country as the elephant, but is very rarely seen, though its tracks are not uncommon. A horn was found some years ago near the source of our valley river.

54. **Nilgiri Tahr.** *Hemitragus hylocrius.* Tam. *Varai Ādu.*

A very common animal on all the high grass-slopes to the south of our valley. Precipitous rock faces daunt it not at all. We have often seen it wandering across very steep precipices. It is visible on the upper open slopes from our houses in the valley. Quite small young ones have been observed in September. A herd of about forty was seen on 2-4-46. It definitely seems to be on the increase.

55. **Sambar.** *Rusa unicolor.* Tam. *Milā.*

Also very common and constantly met from the foothills to the highest summits. They are not very shy, and certainly on the tops of the mountains, graze by day as well as by night. Twice recently we have met one grazing about midday well out in the grass from the shola edge. In one case the stag saw us and watched us for about ten minutes. Its tail was held straight up, and it kept slowly lifting its right fore-foot and stamping on the ground. It was very inquisitive; after a few minutes a young stag with single unbranched horns came up and stood watching us too. Then they both walked slowly away, not at all alarmed. It was 2.0 o'clock in the afternoon in cloudless sunlight, so they clearly use the day as well as dusk for feeding. Their fearlessness and great numbers are due probably to their being little hunted in these parts. Long may it remain so. We have twice had sambar as pets, but they grow rather large and strong. The best memory is of a young one, trotting up and down the grass paddock where it lived.

56. **Spotted Deer.** *Axis axis.* Tam. *Pulli Mān.*

Reported to be in the large comparatively level areas of forest above Pavanasam, thirty miles north west of us. I have never seen one in its wild state.

57. **Indian Mouse Deer or Chevrotain.** *Tragulus meminna.* Tam. *Koorān* or *Saruhu Mān.*

Common in evergreen forest, coming quite close to our houses. In May 1928 one ran into the house by mistake and was kept, but it soon died, as no one knew what to feed it on. In September 1943 several times we found one in its day dormitory under a low bush in the forest, in one case it was only six yards from the house-wall. When disturbed it would rise and, after a few beautiful little jumps stand perfectly still. The colours of its coat blended perfectly with the sunlight-dappled forest floor. No doubt this helps to make it invisible by day to its enemies for I have passed several times within a foot or two of it, as it lay only sheltered by a few sticks without seeing it.

58. **Barking Deer or Muntjac.** *Muntiacus muntjak aureus.* Tam. *Kēlai Ādu.*

It is also called Jungle Sheep. The second half of its Tamil name means sheep, but I cannot find what the first word means. It is found in jungles not far north of us, but I have not seen it in our immediate area, though it may possibly be in the mountain-top sholas.

59. **Black Buck or Indian Antelope.** *Antilope cervicapra.* Tam. male—*Kalai,* female—*Pulvāy.*

Found in some long, low hills out in the open plains east of Tinnevelly Town, and in several such places in the north of the district. In August 1946 someone gave us a fawn two weeks old, one of a pair caught together, which is quickly becoming a most delightful and obedient pet. This is a male. Even at this age, though the coat is almost a uniform fawn colour, the line of colour demarcation on the sides is clearly visible (see accompanying photograph). We feed it on milk and grass. At 2½ months old it can easily outpace any of our boys. It runs 'flat out' for some distance and then makes a series of three or four bounding leaps which are most extraordinary to watch. It also trots beautifully. They are kept as pets by Muslims in some parts of the district; and the female especially is reported to be easily domesticated.

60. Indian Wild Pig. *Sus cristatus* Tam. *Kāttu Pandri.*

Common in the foothills in scrub-jungle. It does a great deal of damage to paddy fields near the foot of the hills. We have seen it a number of times on the paths leading to the forest. As many as nine quite small piglets have been seen at one time, but I am not sure whether this was one litter or two living together.

PANGOLINS.

61. Indian Pangolin. *Manis pentadactyla.* Tam. *Arungu.*

It frequents grassy open hillsides from the foothills at least two-thirds of the way up to the summit of the mountains. It lives in long burrows which in ordinary forest earth may extend for twenty feet. In rocky ground five or six feet is enough. In November 1939 a female was washed down by floods and found stranded on the margin of a 'tank' near us. We kept it for four days (not an easy task for it could escape from almost any confinement) and then it disappeared one night. But we learned a lot in those four days! It performed before several hundred children and adults. It climbed trees, hanging head downwards from a branch. If it fell off, it merely rolled up in mid air and reached the ground unhurt. It walked down the steps into a large well we have, drank, bathed and finally swam across to the other side, its front paws doing a 'dog-stroke' and its tail waving from side to side in the water. When climbing up the steps out of the well, some were rather high, but it used its tail-scales very cunningly as a kind of lever with an anti-slip device. Walking, it is surprisingly fast, and it holds its heavy armoured tail out straight behind it, just off the ground. It ate termites and black ants. Its long tongue shot in and out at great speed to catch the ants as they ran away. And after drinking it licked its lips in the most amusing way. Its front feet are rather like those of a tortoise. It walks on the side of the foot and the powerful claws can dig at a tremendous rate, all four legs working together, the front two to dig and the back two to shovel the earth out backwards. When frightened or 'fed up' with too much attention, it folds its head inwards, puts its two front paws over its head, and finally curls up its tail over all to make a round ball. It used to make a kind of gentle hissing noise as it rolled up or just after. We were very sad when it disappeared.

CAECA OF SOME INDIAN BIRDS.

BY

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(*With a text-figure.*)

It is well known that colic caeca show great variability in form and size in birds, and they have been utilized in the systematic consideration of birds (Beddard[1]). It has been noted by Newton[2] that mere presence or absence is no good criterion in taxonomy, but their state of development is of much importance; and that there exists certain correlation between the caeca and the length and width of the large intestine. Stuart Baker[3] mentions the forms of caeca as characters for several major divisions. Besides, it is believed that there exists some relation between the state of development of caeca and the food habits of birds, at least in several groups of birds.

In course of our[4] studies on the arterial arches of birds we examined the conditions of caeca and have kept records of their shape and size as also their site of origin in relation to the cloacal opening. In view of diverse shape and size of the caeca which could hardly be expressed in suitable descriptive terms, we have taken resort to faithful sketches of all the forms studied by us. The table below provides the measurements of length and width of caeca as also their sites of origin measured from the cloacal opening. Stuart Baker's (*op. cit.*) classification is adopted in the systematic arrangement of the species in the table, and we take this opportunity of recording our sincere thanks to Dr. S. C. Law, M.A., Ph.D., for the identification of birds.

We did only 52 different species belonging to 23 families in 7 orders, of which 35 species are provided with caeca and the rest (17 species) are without them. Great diversity is observed in Coraciiformes not only from the point of view of their presence or absence but also from their shapes and sizes. Viewed from the ventral side of the dissection of the bird, the caeca are in most cases lateral in origin as usually stated but ventro-lateral origins are not also wanting in practically all the groups. In some instances a pronounced asymmetry in the origins (Figs. 2, 26, 32) is observed, but we cannot vouch for its truth as we examined only one specimen each. An asymmetry in length of the two caeca is likewise observed in a few cases (Figs. 3, 21, 24, 25, 35). The free ends of the caeca are pointed in some cases, while the shorter caeca are generally blunt at tips. In long caeca the free ends are swollen and gradually tapering at ends excepting those of *Cuculus* (Fig. 17) where they are blunt at tips and distinctly club-shaped.

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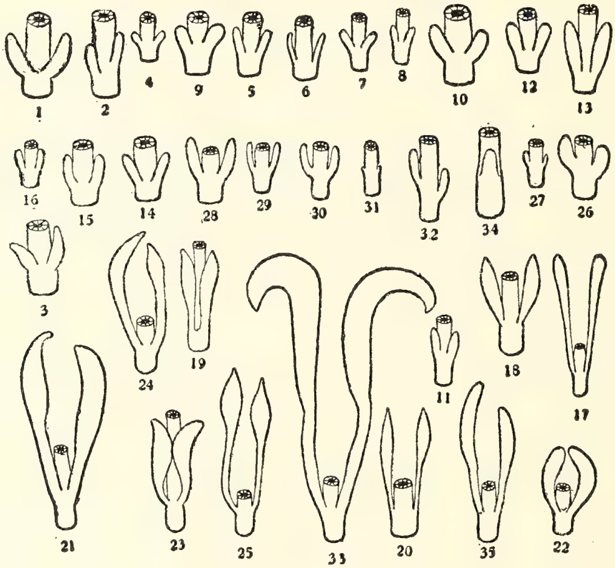
[1] Beddard, F. E. (1898), The Structure and Classification of Birds.

[2] Newton, A. (1896), A Dictionary of Birds.

[3] Stuart Baker (1922-29), *Fauna of British India*—Birds—I-VI.

[4] Bhaduri, J. L. & Biswas, B. (1945), 'The Cervical and Thoracic arteries of Birds', *Proc. Nat. Inst. Sci. India,* Vol. xi, No. 3, pp. 236-45.



The origins of caeca measured from the cloacal openings are very varied in different families. Some families, like *Dicruridae, Cuculidae,* etc., show close approximation of measurements. These ought to indicate some close relationship in the members of the families, but more species need to be worked out before we can arrive at any conclusion.

Attempts have been made to correlate this structure with food habits of birds, but they proved abortive in a general way, although in some groups there are elements of truth of this fact. Our studies are too meagre at present to warrant any conclusion, but sufficient to suggest that further records in different species, comprehensive of genera and families, will be helpful not only in throwing light on the systematics of the group but also in evaluating the affinities running between them.

TABLE

Showing the measurements (*in millimetres*) of the caeca and their position in relation to the cloacal openings. (R = right ; L = Left).

Name	No. of specimens	Maximum		Distance from cloacal opening	Fig. No.
		Length	Width		
PASSERIFORMES					
Corvidae					
Corvus s. splendens Viellot	4	6·0	2·0	8·0—16·5	1
Dendrocitta v. vagabunda (Lath.)	1	4·5	1·0	R. 17·5 L. 20·0	2
Timaliidae					
Turdoides somervillei terricolor (Blyth) ...	1	4·0	2·0	14·0	3
Aegithina t. tiphia (L.) ...	1	1·5	0·75	10·0	4
Pycnonotidae					
Molpastes cafer bengalensis (Blyth)	2	3·5	1·0	5·0—9·0	5
Otocompsa jocosa emeria (L.).	1	4·0	0·5	21·0	6
Turdidae					
Copsychus s. saularis (L.).	1	3·0	1·25	12·75	7
Pericrocotidae					
Pericrocotus p. peregrinus (L.)	1	2·0	0·75	6·0	8
Artamidae					
Artamus fuscus Vieillot ...	1	3·25	2·0	23·0	9
Dicruridae					
Dicrurus m. macrocercus Vieillot	1	4·75	2·0	17·0	10
Chibia h. hottentotta (L.) ...	1	8·25	1·25	16·0	11
Sturnidae					
Sturnia m. malabarica (Gmel.)	1	4·0	1·5	11·0	12
Acridotheres t. tristis (L.)	1	7·0	2·0	11·5	13
Acridotheres ginginianus (Lath.)	1	4·0	1·0	10·0	14
Sturnopastor c. contra (L.).	4	4·0	1·25	7·0	15
Ploceidae					
Ploceus p. philippinus (L.).	3	2·5	1·0	8·0	16
CORACIIFORMES					
Picidae					
Yungipicus nanus brunneiceps Baker	1	Absent			
Brachypternus b. benghalensis (L.)	3				
Capitonidae					
Thereiceryx zeylanicus caniceps (Frankl.) ...	3				
Cyanops a. asiatica (Lath.)	5				
Xantholaema haemacephala lutea (Less.) ...	3				
Cuculidae					
Cuculus m. micropterus Gould	1	15·5	1·5	35·0	17
Hierococcyx varius Vahl ...	2	18·25	4·0	33·0—35·0	18
Clamator j. jacobinus (Bodd.)	1	21·5	3·75	36·0	19

TABLE I—(*Continued*)

Name	No. of speci-mens	Maximum		Distance from cloacal opening	Fig. No
		Length	Width		
CORACIIFORMES—*cont.*					
Cuculidae—*cont.*					
Eudynamys s. scolopaceus (L.)	2	27·0	3·0	33·0—32·0	20
Centropus s. sinensis (Stephen)	1	40·0	6·5	38·0	21
Psittacidae					
Psittacula eupatria nipalensis (Hodgs.) ...	1	Absent			
Psittacula krameri manillensis (Bechst.) ...	3				
Psittacula c. cyanocephala (L.)	2				
Coracidae					
Coracias b. benghalensis (L.)	1	20·25	4·0	16·0	22
Meropidae					
Merops o. orientalis (Lath.)	2	11·25	2·25	9·0	23
Alcedinidae					
Ramphalcyon capensis gurial (Pearson) ...	1	Absent			
Halcyon s. smyrnensis (L.)	3				
Halcyon pileata (Bodd.) ...	1				
Halcyon smyrnensis fusca (Bodd.)	3				
Sauropatis c. chloris (Bodd.)	2				
Upupidae					
Upupa epops orientalis Baker	3				
Asionidae					
Otus bakkamoena marathae Ticehurst	1	28·5	4·0	14·0	24
Athene brama indica (Frankl.)	3	36·5	5·25	14·0—17·0	25
ACCIPITRES					
Falconidae					
Milvus migrans govinda Sykes	1	4·75	2·0	R. 48·0 L. 47·0	26
Astur badius dussumieri (Temm. and Laug.) ...	1	1·25	0·60	16·5	27
COLUMBIFORMES					
Columbidae					
Crocopus p. phoenicopterus (Lath.)	1	Absent			
Dendrophasa b. bicincta (Jerd.)	1				
Chalcophaps i. indica (L.)...	1				
Columba livia intermedia Strick. (Domestic) ...	5	5·0	1·5	19·0—20·0	28
Streptopelia chinensis suratensis (Gmel.) ...	2	3·5	0·75	15·0—17·0	29

TABLE I—(*Continued*)

Name	No. of specimens	Maximum		Distance from cloacal opening	Fig. No.
		Length	Width		
COLUMBIFORMES—*cont.*					
Columbidae—*cont.*					
Streptopelia senegalensis cambayensis (Gmel.) ...	1	3·0	1·0	25·0	30
Streptopelia d. decaocto (Frival.)	1	0·5	0·25	27·0	31
Oenopopelia t. tranquebarica (Herm.) ...	1	3·5	1·0	R. 19·0 L. 17·5	32
GALLIFORMES					
Phasianidae					
Gallus gallus murghi Rob. and Kloss (Domestic) ...	1	102·0	8·25	47·0	33
HERODIONES					
Ardeidae					
Bubulcus ibis coromandus (Bodd.)* ...	1	3·5	2·0	36·0	34
ANSERIFORMES					
Anatidae					
Querquedula querquedula (L.)	1	31·0	3·5	41·0	35

* Only one caecum is present.

FISHING CONTRIVANCES USED IN H.E.H. THE NIZAM'S DOMINIONS.

BY

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Hyderabad State contains 30,219 large tanks numerous smaller ones and 468.05 miles of canals besides many large and small rivers and irrigation reservoirs chief of which are Nizamsagar, Alisagar, Singtom reservoir (Nizamabad district), Osmansagar, Himayatsagar, Mir Alum tank and Hussainsagar (Hyderabad and suburbs), Pocharam lake (Medak district) Dindi and Pindlipakla reservoirs (Nalgonda district), Pakhal, Laknawaram, Ramappa lakes, Wyra and Palair reservoirs (Warangal districts), Rooti reservoir (Bhir district) Moyal Marchaid reservoir (Raichur district).

Most of the tanks are directly or indirectly fed by the rivers and canals and are thus stocked with fish during the rains. Fishes breed in the reservoirs, up the anicuts and in the rivers, and fish-fry are carried along with the current to the tanks or when the rivers and tanks are flooded breeders go up the current and breed in the tanks.

All these natural resources are at our disposal, if properly and scientifically exploited, it is possible to supply fish throughout the Dominions at a cheap rate within the reach of everybody. Fish as a diet can also easily be included in the daily food of the villagers and farmers if a little attention is devoted towards its breeding, conservation of the fry and improved methods of fishing.

Here we will first describe the fishing methods which are at present in vogue.

Nets.

Cast net, which is locally called *'Santola'* is the most common net and is in universal use owing to its simplicity and low cost. The meshes vary according to the size of the fish to be caught, being from ¼" to 2". The smallest meshed nets are used for collecting fish-fry from tanks or other waters for stocking smaller tanks and pools. This net has its limitations and can be used only in shallow and clear waters, free from weeds and vegetation, which does not allow the weights of the net to sink to the bottom and so permit fishes to escape. It is sometimes used from the boat also but to very little advantage. For catching small fish or fish-fry the bait in the form of a mixture of rice, husks and 'Konda' is placed beforehand in the tank to attract fish, and after an hour or so the net is cast. Sometimes fishermen throw stones to attract fish and then cast the net.

Another way of catching fish up an anicut where the water is not deeper than 4 ft., or in other shallower parts of the tank, usually in 3-4 ft. depth of water, is where ten to fifteen nets are taken together and the fishermen move towards the shallower part, or towards the anicut, as the case may be, then each net is released and hauled independently. There are yet many other means to which this net is put to. *Drag nets,* with floats above and weights below are usually used in the tanks which are practically devoid of vegetation and stones. These are very common in the River Godavari near Nander and adjacent parts of this district but are not commonly met with in other parts of the dominions except where there are rivers with sandy bottom. The size of the meshes varies according to the size of the fish to be caught being ¾" to 2½" from knot to knot. The length of each net ranges upto 300 yards or even more with a depth varying from 15 to 20 feet. This consists of small pieces tied together which can be attached or detached according to requirements. Sometimes a large-size purse is kept at the middle of the net where fishes collect and are trapped. It is really very interesting to see thirty to forty fishermen plying this net; the quantity of fish caught is usually quite large. At Nander in one net we got more than 30 seers of fish including large-sized 'Mahaseer' and 'Rohu'. This net is locally known as 'Mahajal'.

Another type of drag-net is used for catching prawns in the Godavari river at Nander and other places. This net is known locally as *'Ghan-ka-Jala'*. It is made of three or more flaps which taper towards their distal parts and form a sort of pocket and their margins are inverted inwards; weights are tied so that they may sink to the bottom and floats keep the mouths of the flaps open. Long ropes are tied to each corner of the net and on these clumps of leaves are tied to frighten the prawns so that they may be driven towards the net. The net is dragged for about three furlongs and then drawn towards the shore taking with it prawns and other small fishes which keep near the bottom of the river.

Bag net or *'Edai'* is commonly used in 'nalas' and streams for catching fish which come down the stream with the current. At first the main course is blocked by means of big boulders and stones and a small passage is left between them. The net is tied to the two sides of the opening and left in position. It is hauled up from time to time and fish collected at the cod end taken out. The meshes of the net become gradually smaller towards the cod end. This type of net is commonly used in the two 'nalas' feeding Hussainsagar during the rainy season for catching small fish, but its use is now prohibited. The practice destroys the fish-fry in the very early stages.

Sometimes this net is used in combination with a trap which is still more harmful for the fish-fry and its use should also be discouraged.

In the Tungabhadra river at Alumpur, the purse-net is used as a drag-net and is found to be quite successful in catching big-sized fishes. It is in the form of an open purse with two wings to which ropes are tied; palm leaves are fastened to the ropes for frightening and driving the fish towards the mouth of the net. The lower jaw of the mouth is weighted and floats are attached to the upper one to keep it open. When dragged, the fishes collect towards the mouth and enter the cod end of the net where they are imprisoned. They are taken out of the net after unfastening the cod end string.

Stake nets are of two kinds one of which is for catching fishes coming up or going down the current in streams connected with the rivers. Four sticks are fixed to the ground and nets spread across them which go down to the very bottom of the small stream and a swing arrangement is made for catching the fish. Fishes coming in contact with the obstacle so formed, try to jump and clear it and land into the swing net. This type of net was seen in use during rainy season near Godavari river where small 'nalas' join it.

The other type of stake net is a smaller one used in shallow water. It is a rectangular piece of net with sticks fixed at intervals of about two yards and small pockets are formed between these sticks. These nets are fixed to the ground in shallow water and the fishes driven towards them by the fishermen splashing the water and making noise. The sticks are then removed and the pockets searched for fish. These nets are used for 'murrels' and *Notopterus*. It is known locally as *'Tursanum boola'*. Cast nets are also used in a similar manner for catching 'murrel' on the margins of the tanks and in the weedy parts where they cannot be thrown. Locally it is called *'Urtoo'*.

Gill nets, or *'Kuchoola'* of varying meshes are not very common here, because the fishermen do not possess boats. Only at some places they use logs of wood and ply the nets in deeper parts of the tank. These are left during night at some place. One end is tied to the shore to prevent drifting too far. They are taken out in the morning. Carps, Siluroids and other flat fishes are commonly caught, but tubular fishes like 'murrel' escape the meshes. If boats are provided and nets of varying meshes are employed we are sure the catch will increase to a great extent. The limited use of these nets is due to the poverty of the fishermen; with a little help and encouragement their use can be made common. *Triangular hand-net*, or *'Turstopda'*, is employed almost everywhere in the State and its catch is usually confined to shrimps and small fishes.

Fish-traps.

The *Cover-basket* (*Oola*), open at both ends, the diameter of the upper end being smaller than that of the lower one, is used for catching fish in very shallow water, specially in the muddy bed of a drying tank or pond. The fisherman puts it where he suspects there is a fish and then searches for it inside with his hand. We have seen this sort of basket being used in Haldi river at Medak and in other parts of the Dominions.

Basket-traps (*Pinjara*) prepared on the principle of mouse trap are in common use, they are used with or without baits. 'Murrel' and other smaller fishes are caught but this practice should be discouraged as it results in the destruction of fish-fry.

The *Field trap* (*Guda*) is in common use where fields are irrigated by canals. Its form is conical with open mouth and tapering towards the other end where a trap is provided. Small fishes and fish-fry coming down the current are caught. Its use is very harmful as it tends towards the wholesale destruction of fish-fry and therefore should be discouraged.

Murrel noose (*Chikkam*). It is a tubular apparatus made of fibres or grass with one end closed and it is generally used in the breeding season of this fish. It is fixed in the evening just near the spawning ground, the fishes come towards the shallower parts to breed, try to pass the obstacle and are entangled in it, sometimes two to three are caught in one noose. In the morning the fishermen take out the nooses with the entrapped fish; this practice is also injurious to the breeding of the fish because ripe female breeders are usually caught and destroyed.

In the Manjra river at places the fishermen collect stones and boulders so that the current passes through the space left between them. Here in the inter-spaces platforms of sticks are constructed. The current passes through these sticks and fishes coming with the current are hurled on to these platforms. These are locally called *'Mudgi'*.

Other Methods.

Line and hooks are usually employed. They are cast in the tank near the shore at about 5 p.m. with baits consisting of live frogs, small fish, crabs, etc., and are taken out next morning. The catch consists of 'Murrel', cat-fishes and *Notopterus* as they are carnivorous and take live bait readily. Sometimes *Anguilla* (Tamboo) is also caught. Locally this line with hooks is called *'Daouni'* and each bears about one hundred hooks.

Sometimes individual lines are used with single or treble hooks and are thrown from the shore to a distance of 15-20 yards.

In some places, viz., Moyal Merchaid in the Raichur district people use a kind of oily stick; it is burnt and used as a torch for attracting fish. They stand on the anicut and watch for the fish coming towards the fire, big fishes are attracted towards the light, they are then beaten with sticks and caught.

In the hilly tracts cruives and different kinds of fish-traps are common. In shallow pools, the water is baled out and the fishes caught. Poisoning by means of leaves, bark, fruits and roots of many shrubs is a very common practice in Adilabad, Nirmal, and hills of Mahboobnager district, but is not so common in other parts of the dominions. This is a harmful practice as it tends towards the wholesale destruction of fish and should be controlled.

Suggestions.

Small-meshed nets and fish traps are very destructive as they take small fishes and fish-fry, which if left to grow would fetch a better price, and if let into a tank would breed and add to the fish-wealth.

Legislation should be enforced to restrict meshes of the nets, and small-sized meshes should only be allowed for the collection of fish-fry for stocking purpose under the supervision of responsible persons. Better than legislation would be to educate the fishermen, and it should be made clear to them that the destruction of fish-fry and small fish is detrimental to their own interests. They should be taught to culture and breed fish near their own lands adjacent to the fields so as to get fish for their own daily consumption; extra fish they can send to the market.

The deep-water netting is not prevalent in the State because the fishermen do not possess boats and are not rich enough to purchase large nets. With a little encouragement and demonstration it is very easy to establish deep-water netting and thereby increase the fish-supply. It will be possible then to exploit deep perennial tanks and other reservoirs which are hitherto uncared for owing to lack of proper fishing gear.

'Oosa Valai' an encircling gill-net improved by the Madras fisheries department for deep-water netting should also be introduced; this will require a large-sized gill-net with big meshes and two boats. It is used early in the morning and late in the evening when fishes come to the surface.

In our rivers practically no fishing is done during the rainy season when rivers are in flood. Drift-nets or *'Rangoon Valai'* as used for catching 'hilsa' in the Godavari near Rajahmundry may be tried with advantage. These nets have got floats, but no weights and are plied from a boat for catching fishes coming upstream. Similarly, a purse net or *'Shangla-jal'* which is used for catching 'hilsa' from a boat in the Hoogly river may also be tried.

Acknowledgements.

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SOME COMMON INDIAN HERBS WITH NOTES ON THEIR ANATOMICAL CHARACTERS.

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(*With three plates.*)

(*Continued from page 246 of Vol. XLIV, No. 2*).

XII—*Enicostemma littorale* Blume

(Gentianaceae).

Synonymy and Systematic Description.

Enicostemma littorale Blume, Bijdr (1826), 848, H.F.B.I., IV, 101; Cooke, Fl. Pres. Bomb., V., II, Pt. 1, 189; Gamble, Fl. Pres. Madras, Pt. V, 875. Syn: *Slevogtia maritima* Dalz. in Kew Journ. Bot. V. 2 (1850), 137. *Adenema Hyssopifolium* G. Don, Syst. V. 4 (1837), 201; Wt. Ic. t. 600. *Hippion orientale* Dalz. & Gibs., 157.

A perennial glabrous herb 4-10 in. high, branched from the base, and from a thick rootstock; stems or branches erect or procumbent, sub-quadrangular, glabrous. Leaves sessile, opposite, very variable, linear-oblong, 3-nerved at base, the midnerve very prominent, marginal nerves obscure. Flowers small, sessile, in axillary clusters. Calyx deeply 5-lobed. Corolla white, tubular below and funnel-shaped above; lobes 5, lanceolate, overlapping to the right in bud. Stamens 5, inserted at the middle of the corolla-tube; filaments filiform with a small double-hooded scale at the base; anthers erect, acute. Ovary 1-celled; placentas little intruded; ovules many; style short; stigma capitate. Fruit an ellipsoid capsule. (Plates I & II). Flowers Aug.—Jan. Medicinal (Kirtikar, 5; Watt, 10).

Indian Names.

Krimihrita, Kshara Karma (Sans.); Chota Kirayata (Hind.); Vallari, Vellaragu (Tam.); Nelaguli (Tel.); Kadavinayi, Mamijva (Mar.); Nagajivha (Beng.).

Habitat.

Throughout India, from the Punjab and Gangetic Plain to Ceylon; more frequent near the sea, not known in Bengal (Hooker, 4; Cooke, 1); all plains Districts and to 1500 ft. in the hills, chiefly however near the sea, often on black cotton soil (Gamble, 3); Gujarat, common; Concan rare (Dalz. & Gibs., 2); A common weed (Mayuranathan, 6); very common in *morum* (gravel) soil and dry places at Adigmet and elsewhere (Sayeedud-Din, 8).

Distribution.—Malaya, Tropical Africa, W. Indies.

Anatomical Notes.

Structure of the leaf. (Plate III, Figs. 1 and 2). The cuticle is striated, and the epidermis consists of large cells with outer walls greatly thickened. The epidermal cells at the margin have both the inner and outer walls greatly thickened, and the latter convexly arched outwards. A few collenchymatous cells are present at the margins. Stomata occur more on the lower than on the upper surface, and do not belong to any special type, the guard-cells being surrounded by ordinary epidermal cells. The stomata are not buried in the epidermis as would be expected in a plant of this type, but on the contrary the guard-cells are elevated and the front cavity is on a level with the surface. The mesophyll is not differentiated into palisade and spongy cells, but consists of uniform polygonal assimilatory cells. These observations tally with those made by Sabnis (7).

Internal secretory organs and clothing hairs do not occur either in the leaf or in the axis. The vascular bundles of the veins are bicollateral.

Oxalate of lime occurs in the form of small clustered crystals mostly in the pith. It is wanting in the leaf.

Structure of the axis. (Plate III, Fig. 3). The cuticle is striated. The epidermis consists of tabular cells with both the inner and outer walls thickened. The cortex is composed of chlorenchyma, but the cortical cells in the ribs are collenchymatous. In the pericycle a ring of sclerenchyma is not present. The vascular bundles are bicollateral, the rings of soft bast being continuous on either side. The medullary rays are narrow and uniseriate. The vessels are small and arranged in rows. Wood-prosenchyma which is little developed, is not provided with more or less typically differentiated bordered pits as recorded by Solereder (9) for other members of the *Gentianaceae*. The pith is composed of thin-walled cells.

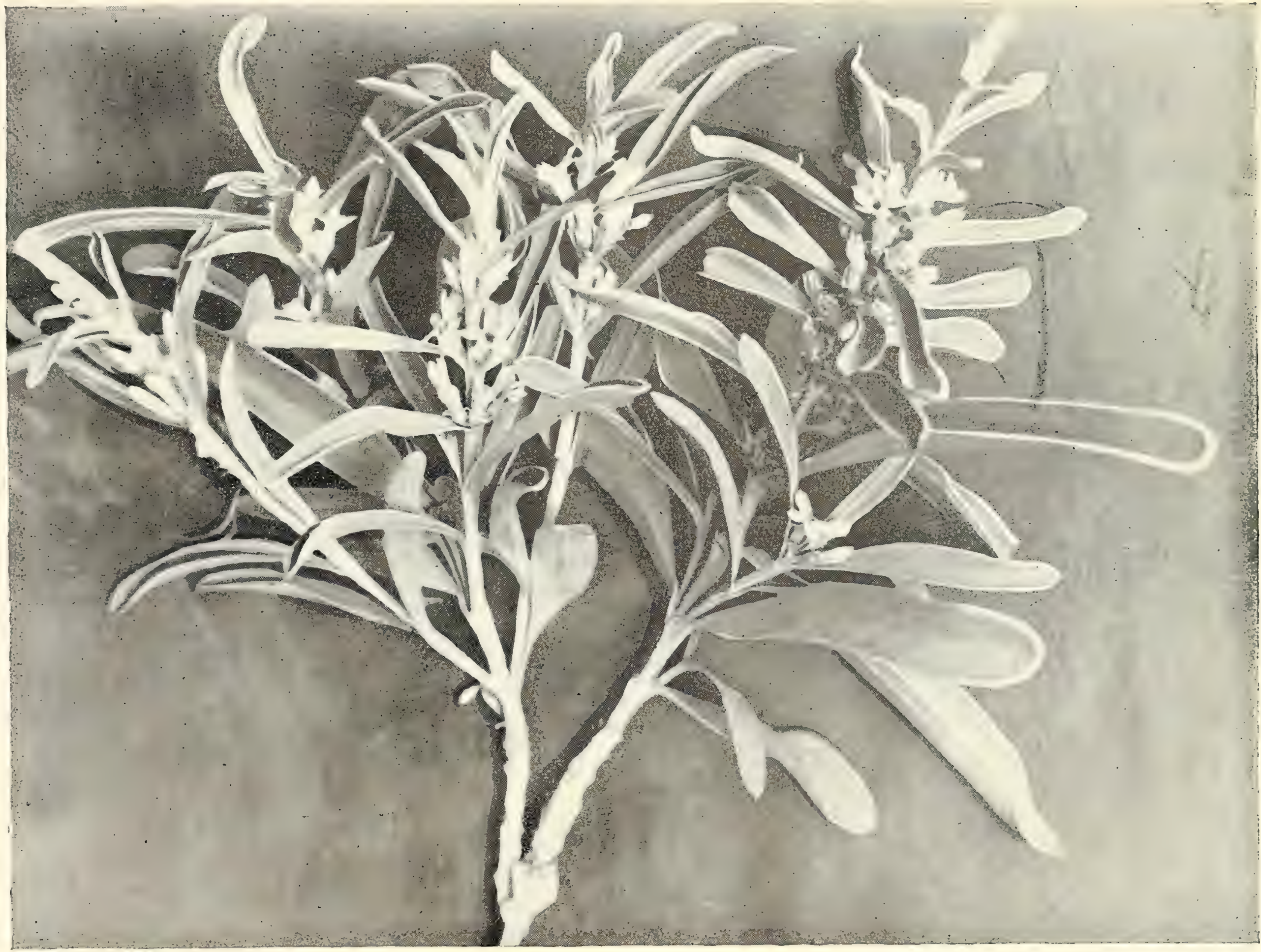
Structure of the root (Plate III, Fig. 4). Stone-cells occur in the pericycle. A pith is not present. The decaying of the primary cortex as recorded by Solereder in the *Gentianoideae*, has been observed.

CONCLUSIONS.

1. Stomata are surrounded by ordinary epidermal cells, and hence do not belong to any particular type.
2. Oxalate of lime occurs in the form of small clustered crystals only in the stem.
3. Clothing hairs and internal secretory organs are wanting.
4. Mesophyll is composed of uniform polygonal assimilatory cells.
5. In the axis, the vascular bundles are bicollateral, and a ring of sclerenchyma in the pericycle is not present.
6. In the root, stone-cells are found in the pericycle. There is no pith.

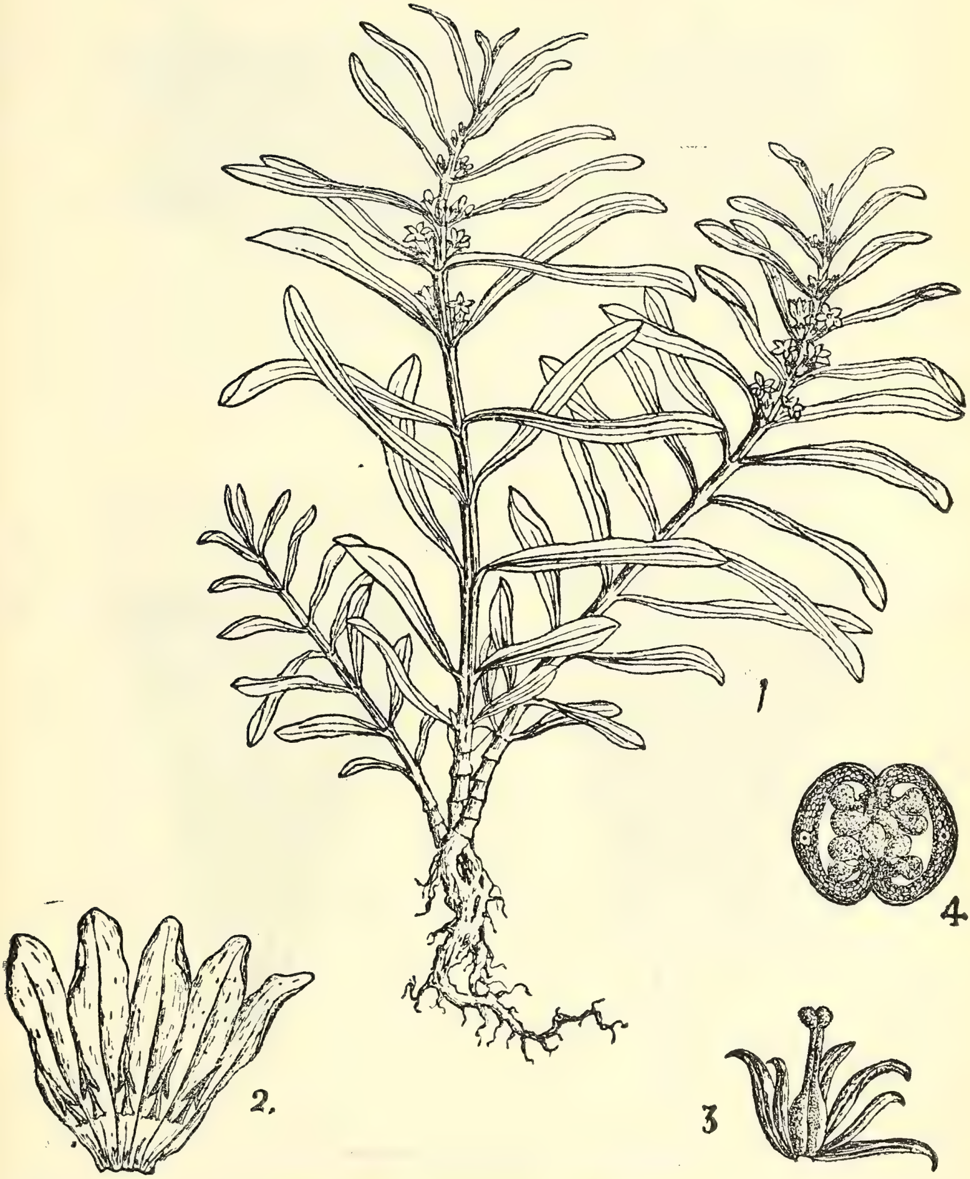
ACKNOWLEDGEMENTS.

I am thankful to my pupil, Mr. Maheshwar Raj Suxena, for the preparation of micro-slides, and to Mr. Sri Ramloo for the photograph and the drawings.



Sayeedud-Din.— **Enicostemma littorale** Blume.

For explanation see end of article.



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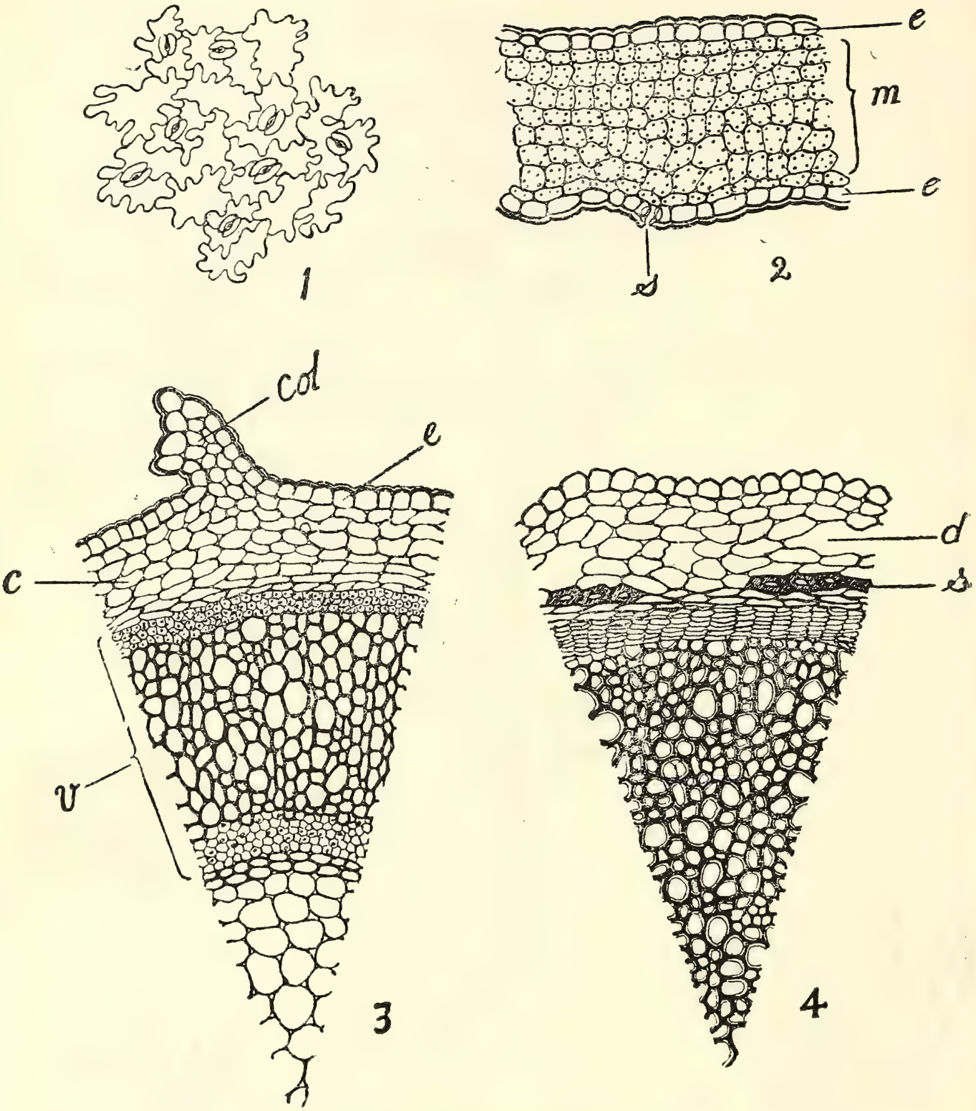
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Sayeedud-Din.—**Enicostemma littorale** Blume.

For explanation see end of article.

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EXPLANATION OF PLATES I—III.

PLATE I.

Photograph of *Enicostemma littorale* Blume.

PLATE II.

Fig. 1.—Black and white drawing of *Enicostemma littrole* Blume. (Nat. size).
Fig. 2.—Corolla opened out. (× 10).
Fig. 3.—Pistil with calyx attached. (× 10).
Fig. 4.—T. S. Ovary. (× 10).

PLATE III.

Fig. 1.—Leaf-epidermis, showing stomata. (× 215).

Fig. 2.—T. S. Leaf, showing: s,stoma; e,large epidermal cells; m,undifferentiated mesophyll. (× 215).

Fig. 3.—T. S. Stem, showing: e,tabular epidermal cells; c,cortex composed of chlorenchyma; col,collenchyma; v,bicollateral vascular bundles. (× 215).

Fig. 4.—T. S. Root, showing: d,decaying of primary cortex; s,stone cells. (× 215).

STUDIES ON THE SPOTTED BOLLWORMS OF COTTON—*EARIAS FABIA* S., AND *E. INSULANA* B.

BY

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Cotton buds and bolls are subject to varying degree of damage by caterpillars of *Earias fabia* S, *E. insulana* B, *Platyedra gossypiella* S, *Heliothis armigera* F and *Rabila frontalis* W. In Coimbatore, the latter two do occur but in such sparse numbers and at only certain periods of the growth of cotton that they had at no time gone beyond the stage of minor pests, though in countries like *America* and *South Africa Heliothis armigera* F had easily attained the rank of one of the serious major pests of cotton. Caterpillars of *Earias fabia, E. insulana* and *Platyedra gossypiella* are easily the most destructive and cause considerable damage to the growing buds and bolls. Fletcher and Misra (1921) have given an account of the former but it relates mostly to the pest as prevalent in N. India. Recently, Deshpande (1936) has made a valuable contribution on the spotted bollworms as far as they relate to Bombay. As yet there has been no published record of the spotted bollworms relating to S. India which would give a connected account of the worms as they prevail in the south. The need for such a contribution is obvious and an attempt is made in this paper to supplement the knowledge in that direction. This paper exclusively deals with the spotted bollworms under Coimbatore conditions.

Seasonal incidence

(*a*) *General.* The cotton season starts from September-October months when both Cambodia and rainfed cottons are usually sown. The indications of borer attack are first discernible in November when the affected top shoots show signs of withering. The spotted bollworms as they try to make their way into the stem and branches through the axillary and apical buds cause destruction to the latter. They feed on the core of the stems and this results in growth ceasing altogether above the region of damage. It is claimed that this kind of damage does really good to the plant in certain types of cottons by accelerating the production of monopodials on a more extensive scale. Venkataraman and Jagannath Rao (1933) had experimentally proved that such damage to the 'Northerns' in Nandyal tract had given significant increased yield in the plants so affected by top borers. Similar studies, however, made by Ramanathan (1931) in Cambodia and Uppam had given negative results. Though one should welcome an attack of this kind in certain types of cotton, there is always the inherent danger of this kind of initial infection gathering strength and bringing about considerable loss of buds and bolls at the time of heavy budding and bolling. From the stems the caterpillars turn over to the buds and bolls as they begin to appear in late November. Of the two kinds of spotted bollworms that are found here, *Earias fabia* occurs in preponderent numbers unlike in the *Punjab* where *E. insulana* is said to be the most abundant. The latter sometimes appears now and then in the season in cotton buds and bolls but never shows up prominently.

(*b*) *Shed buds and bolls.* Hilson, Ramanatha Ayyar and Chockalingam Pillai (1925) have recorded that the majority of the buds and bolls shed were apparently healthy, unaffected by pests and diseases, and those that were attacked by insects traceable to spotted bollworm damage. It was gathered from their studies that the peak attack was reached in December with 65% damage to the buds and bolls, and thereafter the incidence took a downward trend and touched a very low figure of 5% by the middle of February; again it went upto 20% in May. Attempts were made to study the incidence in the shed buds and bolls of Cambodia of borer attack on a wider basis with a larger material to work on. The work was continued over a period of three seasons in the years 1937-38, 1938-39 and 1939-40. The shed material was daily picked together in the mornings from a plot of two cents and examined the same day for borer incidence. Sometimes the studies had to be suspended due to dearth of material in the field and were resumed when they became available again. The data thus obtained are presented in the Table I.

It will be observed that the caterpillar population was very high from the middle of December to the first week of January in 1937-38 and this period of intense activity of the bollworms coincided with the maximum damage to the buds and bolls and the heavy shedding noticeable then. Thereafter there was seen an abrupt falling off in the population followed by a slowing down of shedding and a decrease in the extent of bollworm damage therein. There was also observable a tendency for the population to rise again in the middle of May to July when shedding became prominent again and the damage pronounced. But in 1939 similar trends were not observable; there was very little of shedding in the months preceding February, and the caterpillar activity as judged from the population percentage would appear to be comparatively low. The maximum percentage of damage and population had never exceeded 2·8 and 1·5 in buds and 3·76 and 2·06 in bolls in the month of February when shedding was most heavy. But in the previous year, i.e., 1937-38, the period of heavy shedding and damage had commenced rather early and the maximum percentages of damage and popu-

TABLE I

Percentage of incidence of spotted bollworm damage and population in Cambodia shed cotton.

Year	BUDS					BOLLS				
	Total examined	Damaged by Earias	Larval population	%age of damage	%age of population	Total examined	Damaged by Earias	Larval population	%age of damage	%age of larval population
1937										
Novr. ii.	679	344	3	50·7	0·5	313	171	23	55·0	7·3
Decr. i.	4203	1600	452	38·0	10·7	6137	2084	715	33·9	11·6
,, ii.	2373	340	57	14·4	2·4	13827	1422	320	10·3	3·3
1938										
Jan. i.	2154	60	6	2·8	0·3	20431	459	60	2·2	0·3
,, ii.	222	19	—	8·6	—	2757	131	11	4·7	0·4
Feb. i ,, ii	..................no shed material..................									
Mar.	..................no shed material..................									
Apr. ii.	127	7	—	5·5	—	84	1	1	1·2	1·2
May. i.	1507	418	60	27·8	4·0	788	73	36	9·2	4·5
,, ii.	7917	548	115	6·9	2·0	1597	359	174	22·0	10·9
June i.	3419	835	211	24·4	6·2	1683	720	361	44·0	21·5
,, ii.	228	103	44	45·0	15·0	461	148	65	32·0	14·1
July i.	896	357	162	39·9	18·2	277	87	71	31·0	25·8
,, ii.	1276	241	97	18·8	7·6	533	163	84	30·6	15·8
Aug. i.	457	180	70	39·4	14·8	1620	478	150	28·9	9·2
1939										
Jan.	..................no shed material..................									
Feb. i.	6780	58	22	0·85	0·33	2462	25	7	1·01	0·3
,, ii.	1142	32	17	2·8	1·5	585	22	12	3·76	2·06
Mar. i.	913	27	28	2·96	3·06	112	10	4	8·9	3·6
,, ii.	395	32	17	8·1	3·96	105	26	14	24·6	13·3
Apr. i.	511	148	30	27·0	5·94	216	71	36	32·8	16·6
,, ii.	1027	237	72	23·07	7·00	256	96	39	37·5	15·3
Decr. ii.	1748	700	152	40·0	8·6	1097	257	113	23·3	10·3
1940										
Jan. i.	7028	1517	726	21·6	10·3	4963	908	555	18·8	11·2
,, ii.	5210	212	57	4·06	4·09	3687	161	59	4·3	1·9
Feb. i.	793	47	20	5·9	2·60	1068	51	13	4·77	1·1
,, ii.	29	7	3	24·0	10·4	836	12	1	1·4	0·1

i & ii indicate fortnights.

lation for the period were 50.7 and 10.7 in buds and 55.0 and 11.6 in bolls. In 1939-40, again, the phases of shedding, damage and population were found taking identical trends as were noted in 1937-38 but the high figures of 1937-38 were never reached. Absence of shedding in the early months of growth and low incidence of bollworm in 1938-39 may be attributable to the continued drought experienced during that period. On the other hand, a high incidence of the bacterial disease caused by *Bacteria malvacearum* was noted to have affected the buds and bolls in that season.

(*c*) *In green and dry bolls.* Though no actual examination was made in 1937-38 and 1938-39, figures for the earlier years have been compiled and are furnished in two separate tables hereunder (Tables II and III).

TABLE II

Percentages of ***Earias fabia*** and ***E. insulana*** in standing green bolls of Cambodia collected from 100 plants.

Year	Jany.	Feby.	March	April	May	June	July
1920	1·79	1·05	5·77	5·30	3·10	2·50	3·10
1922	3·27	1·14	0·29	5·37	18·32	13·13	7·19
1923	3·73	0·53	0·93	1·65	1·80		
1924	0·95	0·92	3·24	6·12	3·40		
1925	7·21	0·91	3·50	12·20	17·10		
1926	1·38	0·79	0·95	3·34	6·80	7·77	12·50
1927	1·44	2·23	3·45	7·40	11·64	10·50	6·64
1928	2·28	0·54	0·87	3·83	2·03		
1929	3·78	1·50	1·50	4·40			
1930	3·95	1·80	3·47	3·02			
1931	1·60	1·30	1·50	11·50			
1932	3·93	3·70	2·50	4·20			
1933	2·80	3·70	4·40	7·99	2·20	1·79	3·20
1934	1·38	0·68	0·71	14·80			

TABLE III

Dry boll infestation by ***Earias fabia*** and ***E. insulana*** in Cambodia cotton for the years 1922–1934.

Year		Bolls examined	Bolls damaged	Bolls damaged by Earias	Locks damaged by Earias	Total No. of locks	Percentage of lock damage
1922	Season	61211	6480	2742	3015	183633	1·6
	Kar	19972	15999	2597	3771	59916	6·3
1923		2599	379	111	120	8797	1·4
1924		863	213	61	75	2589	2·9
1925		1142	193	64	77	3426	2·3
1927		1045	232	80	99	3135	3·2
1928		1784	77	42	40	5352	0·9
1929		1343	167	88	136	4029	3·2
1931		2803	620	191	240	8409	2·9
1932		2477	812	205	370	7431	5·1
1933		3783	717	424	700	11349	6·3
1934	Season	840	654	260	608	2520	25·0
	Kar	1899	955	140	251	5697	4·6

It will be seen that the infestation in the green bolls in the months of January is always low scarcely exceeding 3·95% except in one year (1925) when it shot upto 7.25%. It then steadily and slowly rises and reaches the peak by the end of April when the crop is, as a rule, pulled out on the farms and is no longer available for following up the trend of infestations in subsequent months. Nevertheless, the figures for four years which are available indicate that there is a tendency for infestation to go up beyond April. As regards the damage to locks in dry kapas it seldom exceeded over 6.0% though in one year (1933) as high a figure as 25.0% was recorded.

Nature and extent of damage

The caterpillars bore into the buds, flowers and bolls and feed on the inside contents of the ovaries. They sometimes totally destroy them or bring about shedding. Though an internal borer for most of its larval life the caterpillar has a tendency to withdraw and move out into another bud or boll. This habit which is in contrast with that of the pink bollworm is responsible for more widespread damage observable in the buds and bolls. It has already been mentioned that top boring of the stems is a feature in the early stages of the growth of the cotton. This kind of damage sometimes affects adversely the yields of certain types of cotton by delaying the flowering; it sometimes helps to give an increased yield as well, as noted elsewhere. Being a dirty feeder, the attacked boll even if it should persist cannot be expected to give clean lint when it finally bursts. To this extent the damage must be considered fairly heavy. More often the damaged bolls get hard, mummified and seldom open properly. From the incidence figures for shed buds and bolls it is clear that the spotted bollworms are active early in the season and bring about a severe shedding of the early formed flower buds. According to Hilson (1925) the buds that appear in the period from the middle December to late January are the most efficient in developing into good bolls. Unfortunately, this critical period synchronises with intense activity of the bollworms which results in more widespread attack and consequently more of shedding in this period. The loss under this head is considerable. If the bollworm factor is eliminated at this vulnerable stage and an increase in the stand of bolls secured there will ultimately be more yield at the end.

Alternate host plants

Both the species of moths were found breeding in *Abutilon indicum, A. hirtum, Hibiscus rosasinensis, H. cannabinus, H. esculentus, H. vitifolius, Malvastrum coromandelianum* and *Althoea rosea;* they are not noted on *Thespesia populnea, Sida cordifolia, Hibiscus panduriformis* and *H. subdarifa.* The caterpillars were found right through the year in varying proportions. From the studies made so far, *Hibiscus vitifolius* pods were found to be more heavily infested by the spotted bollworm, nearly 19.0% of the pods being found bored. *Abutilon* spp. are found to carry a larger population of *E. insulana* caterpillars and this finding is in agreement with that of Fletcher and Misra (1921). Infestation percentages in the two host plants i.e., *H. vitifolius* and *Abutilon hirtum* over a period of four years are furnished in the table IV below.

Incidence of spotted bollworms in host plants

Year	Hibiscus vitifolius						Abutilon hirtum					
	Total examined	Total attack	Population		%age of incidence	%age of larval population	Total examined	Total attack	Population		%age of incidence	%age of population
			E/b	E/i					E/b	E/i		
1937	1169	229	189	8	19·6	16·8	906	145	27	31	16·0	6·4
1938	918	155	122	3	16·9	12·5	2748	319	34	195	11·8	8·5
1939	907	169	107	—	18·6	11·8	556	25	—	3	4·5	5·6
1940	767	148	111	—	19·1	14·5	not taken					

NATURAL ENEMIES.

The caterpillars were found to be parasitised under the field conditions. A list of parasites so reared from the field material is given below.

Name	Nature of parasitism	Host and its stage	Plant host
BRACONIDAE			
Microbracon lefroyi D & G.	ecto	*E. fabia* and *E. insulana* caterpillars.	Shed cotton buds, flowers and bolls ; *Hibiscus esculentus* pods.
Microbracon greeni (Ash)	ecto	do.	*Hibiscus vitifolius* pods ; *Abutilon hirtum* & *A. indicum* pods.
Microbracon hebetor (Say)	ecto	*E. fabia* caterpillars.	*H. esculentus* pods.
Bassus n. sp.	endo	do.	Shed cotton buds, flowers and bolls.
Rhogas aligarhensi Quadri.	endo	do.	Shed cotton buds, flowers and bolls and *H. esculentus* pods.
ICHNEUMONIDAE			
Melcha nursei Cam.	endo	do.	*H. esculentus* pods.
CHALCIDAE			
Elasmus johnstoni Ferr.	ecto	*E. fabia* larvae and prepupae.	Shed cotton buds and bolls and *H. vitifolius* pods.
TACHINIDAE			
Actia hyalinata Mall.	endo	*E. fabia* larvae.	Shed cotton buds and bolls.
CHLOROPIDAE			
Polyodaspis compressiceps Duda.	endo	do.	*H. vitifolius* pods.

It will be seen that there are three kinds of Microbracons parasitising the caterpillars under field conditions. *Microbracon lefroyi* parasites which are characterised by the ebony black transverse bands on the 3rd and 4th abdominal segments seem to attack the caterpillars infesting cotton and *H. esculentus* only. They have not been bred so far from caterpillars in *H. vitifolius* and *Abutilon* spp. pods though the host population in the latter was always high and the host plants co-existed with cotton in certain cases and sometimes were situated far off from cotton. *Microbracon greeni* has been found to attack *E. fabia* caterpillars in *H. vitifolius* and *E. insulana* caterpillars in *Abutilon* pods but has never been reared so far from the cotton buds, flowers and bolls nor from *H. esculentus* pods. This behaviour and the disparity in size and color between the two strongly suggest that the two parasites are not identical as is inclined to be regarded by Lal (1939). Laboratory breeding trials have fully borne out the above assumption; the specificity of the parasites had never changed and they always bred true to type. *Microbracon lefroyi* was found to parasitise worms in tender buds, flowers and bolls. It was not much in evidence in well developed bolls. Its activity was evident at the time of heavy production of buds and bolls and it faded off when the budding slowed down. Breeding of this parasite which presented difficulty in the earlier years was made easy by giving caterpillars enclosed in partially cut tender bolls of 1 cm. to 2 cm. diameter, the contents of which were partially scooped out; the cut halves were then sealed with the caterpillar in, by means of a loop of thread. The caterpillars given in this way were easily accepted and parasitised. Further details on these parasites will form the subject matter for another paper which is to be published shortly.

It will be interesting to record that *Eumenes edwardsii* has been found to hunt *E. fabia* caterpillars and stock them in its nest built on the tops of trees.

LIFE HISTORY STUDIES.

The two previously mentioned publications give details on the life history of the two species. It is not intended therefore to cover the same ground once again except where it is absolutely necessary. Both the species are nocturnal in habit. They pair on the 2nd day of emergence and soon after the females commence to lay eggs; egglaying is chiefly confined to the early hours of the night.

Eggs and egg period. Under field conditions the eggs are found all over the parts of the plant, more being observed in concealed situations like the leaf axils, bracts, leaf veins on the underside etc; they are never closely laid but are scattered loosely in twos and threes. Fresh eggs are of deep sky blue tint, with light green sheen at the top; they are of the shape of a crown and are highly sculptured. Within 12 to 20 hours after egglaying, the fertilised eggs develop a pink spot on the crown region and a pink annular band immediately below the crown; on the 2nd day the blue gloss changes to dull buff color but the pinkness of the band becomes very pronounced; on the 3rd day the egg shell becomes dull brown to white and the developing larva is now visible underneath. Larval emergence is more restricted towards the crown region than towards the base. It takes nearly 60 to 72 hours for the eggs to hatch. Moths are capable of laying a maximum of 385 eggs spread over 5-13 days; their longevity does not exceed more than 15 days. The fresh hatchlings have the habit of partly nibbling the egg shell. The fecundity record for *E. fabia* is furnished below. There is not much of difference in the life history details in the two species.

Fecundity record of *Earias fabia.*

Serial No.	Date of emergence of moths.	Date of Egglaying	Total No. of eggs.	Egg laying period in days.	Longevity in days.
1.	4-3-33	6 7 8 9 10 11 12 1 35 54 45	135	4	8
2.	25-3-33	26 27 28 29 30 31 1 2 3 40 82 62 74 33 17 3	311	7	11
3.	27-3-33	29 30 31 1 2 3 10 28 45	83	3	8
4.	10-4-33	12 13 14 15 16 17 84 69 62 35 13	263	5	8
5.	16-4-33	20 21 22 23 24 25 26 27 28 29 58 54 44 39 36 21 22 15	289	8	14
6.	18-4-33	20 21 22 23 24 25 26 27 28 55 42 38 27 38 24 18 9	246	8	11
7.	18-4-33	19 20 21 22 23 24 65 22 8	95	3	8
8.	19 4-33	21 22 23 24 25 26 27 28 29 39 40 39 27 22 26 17 16 9	235	9	12
9.	20-4-33	21 22 23 24 50 66 72	188	3	5
10.	20-4-33	20 21 22 23 24 25 26 15 89 68 60 24 2 9	267	7	8

Larval and pupal periods.—The larval life extends over a period of 10-12 days after which the larvae spin the cocoons and pupate therein; the prepupal period lasts for about 24-36 hours. In the publications so far cited there is no mention made of the characters by which one could distinguish one species from the other in their larval stages. It is possible to distinguish the caterpillars of the two species from the 3rd instar stages. The larvae of *E. insulana* apart from their paleness in color and more extensive creamy color in their body possess well defined finger shaped processes which are wanting in *E. fabia caterpillars.* A description of the advanced *E. insulana* caterpillars is given. *Head*: Clypeus white, two semi lunar smoky black patches on the front united; *Prothorax*: a pair of transverse stripes light black; the anterior bolder and well defined but broken in the middle; an inverted V-black mark in the centre in front of the first stripe; spiracle black. *Mesothorax*: dull olive with creamy white patches interspersed; two pairs of finger shaped processes, one median and the other lateral; the median 2.5 mm. twice as long as the lateral, purplish, topped by single white hair and covered with a felt of purplish hairs; base and the bottom broadly orange. The lateral, white small covered with a felt of white hairs and topped by single white hair; basal end with an orange patch; a big black oval spot between each patch on either side. *Metathorax*: similar to meso but in the lateral pair of processes bigger than that of the meso. *First abdominal segment*: white patches more extensive; two pairs of equal sized processes, one median and the other lateral with white felt of hairs on both; the bases orange; the lateral placed immediately above the black spiracle. *Second abdominal segment*: with only one well developed pair which is lateral, placed below and behind the spiracle; two pairs of big black round patches, one median and the other lateral; the median pair of processes reduced to stumps. *Third abdominal segment*: very much like the first but with a larger white area. *4th, 5th, 6th and 7th abdominal segments*: with the same number of processes as the 2nd and 3rd; the fourth has a large white area with less of black spotting. *8th and 9th abdominal segments*: same as above, the 9th having a median area which is distinctly black and warty. *10th abdominal segment*: median area with a conspicuous shining black warty surface. *Legs*: with a black touch at the coxal end. Pupation is partially on the plant and partially in the soil debris containing shed material. Adults emerge in 7-10 days after pupation. There is so far no indication that long cycle pupae do exist.

Adult emergences and sex ratio.

It has often been observed that, for some reason or other, a few pupae get mummified and there was no emergence of adults from them. The time of emergence is usually restricted to the early hours of the morning between 3-5 a.m. It would appear that the females slightly predominated in number over the males. Out of 138 adults reared in 1933 over a period of two months in March and April, 66 happened to be males, the rest being females.

Non-response to tropisms.

The moths are not usually well attracted to powerful light; nor do they come to traps which are charged with odorous chemicals like oils of Citronella, Geranium, Anisi, bergamol and terpenes like Eugenol, Iso Eugenol, etc. Gingelly oil cakes seem to show very slight attractiveness when soaked in water and exposed in shallow trays in the cotton fields.

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BIRD LIFE IN AN ASSAM JUNGLE

BY

F. N. BETTS.

This paper is intended to give some account of the bird life of a small stretch of country, which I was able to study fairly intensively over a period of three months, from mid-February to mid-May.

The locality was the Jagi Road quarry, lying on the Assam Trunk Road, halfway between Gauhati and Nowgong, just where the first ridges of the Khasia Hills begin to rise from the dead level plains of the Brahmaputra valley.

The particular area under review is bounded on the north by the Trunk Road, and is about 1½ miles in length by ¾ mile in breadth. It consists of a strip of flat ground varying in width from 200 yards to ¼ mile, behind which rises a forested ridge 200 feet high, dropping on the far side to plains level, where a brook forms the southern boundary. To the north, beyond the main road, the plains extend 15 miles or more to the Brahmaputra, a vast expanse of tall thatching grass, swampy 'bhils', and a certain amount of paddy cultivation. To the south the land rises in a series of forest clad ridges, with a general east to west trend, as far as the eye can reach. All this is reserved forest and quite uninhabited. Malaria is very prevalent, and the population, even in the plains, small.

Climate. I was unable to obtain any rainfall figures, but, judging from the vegetation, it is likely to be in the neighbourhood of 80/90 inches. During the period under consideration rain fell, on an average, 3 times a week, usually in the form of heavy thunderstorms during the night, often accompanied by a strong wind. At the time of my arrival in February, the air was comparatively dry with a sharp drop of temperature at night. By the middle of May, it was hot, humid, and steamy both day and night.

Flora. About 2/3 of the area was under forest. The flat, low-lying portion was covered with a dense growth of evergreen, tropical rain forest, forming a solid canopy, the trees overgrown with ferns, orchids and other epiphytes and interlaced with lianas and rattans. A thick undergrowth grew below, straggling saplings, plants of the Strobilanthes type, and a particularly virulent type of stinging nettle. The slopes and summit of the hill were clothed in mixed deciduous and bamboo forest with comparatively little undergrowth. I arrived at the end of the wintering season, when most of the trees and the bamboos had shed their leaves and were bare. The flowering trees, Simul, Erythrina, and the Asoka tree were just coming into bloom. By the time of my departure, the whole forest was in full leaf, and over a part of the hill the bamboos had seeded and died off. A circumstance that made the area of particular interest to me was the fact that the vegetation was very similar in type to that of the part of India with which I am best acquainted: the evergreen and deciduous jungles of the Western Ghats in Coorg and Mysore. Differences, indeed, there were, as is only natural in view of the fact that the Assam forest lies over a thousand miles north of Coorg, but this is partially compensated by the fact that the former is only a few hundred feet above sea level while the latter lies between 2500 and 3500 feet. The annual mean temperature is probably not very different in the two cases, but in Assam, as would be expected from its more northerly latitude, the seasons are much more marked and the temperature range at either end of the scale, greater.

The south depends mainly for its rainfall on the S.W. Monsoon, more than half the yearly total falling during June, July and August, accompanied by a strong wind off the Indian Ocean, which makes this season cool and pleasant, quite unlike the steamy, greenhouse heat of Assam in the rains. In the latter district, the precipitation is spread out over a much longer period, and comes in showers interspersed with hot sunshine. This, combined with the marshy character of much of the valley of the Brahmaputra makes the climate generally far more humid though the actual rainfall may not be much greater. This is borne out by the greater intermingling of evergreen and deciduous vegetation in Assam, and also to some extent by the distribution of bird life.

Although the area with which I am dealing is such a small one, it can be divided into a number of very distinct biotopes.

1. *Evergreen Tropical Rain Forest.* Originally covering most of the flat ground between the road and the hill foot. Now confined to a patch about ¼ mile square at the eastern end of the area, and a thin strip along the base of the hill, running up some way into the various re-entrants and ravines. Also a fairly wide belt along the stream forming the southern boundary. Parts are swampy, and grow beds of broad leaved plants of the cardamom type and a little Pandanus.

2. *Deciduous and Bamboo Forest.* Occupies quite half the area including the whole of the hill. The latter rises in the centre into a dome of granite. Here vegetation is sparse and stunted, giving way altogether on the summit where the naked rock breaks through

in a smooth, gently rounded whaleback. The ridge drops at either end and breaks up into a mass of enormous boulders, some of them 40-50′ in height. Here the vegetation is much stronger, large trees flourishing in the pockets of rich soil in the clefts and rifts, and spreading a network of roots over the stone faces where leafmould lodges and provides nourishment for a host of lesser shrubs and seedlings.

3. *Grass Savannah.* A pure stand of thatch grass a couple of acres in extent on the eastern border.

4. *Secondary Forest.* A stretch of flat land at the foot of the hill at the extreme eastern end of the area. It had been evergreen forest which had been felled some years previously, leaving a number of trees standing though by no means sufficient to form a canopy. A strong secondary growth of shrubs, saplings and ageratum had sprung up, but constant firewood cutting and cattle grazing kept it fairly open. A very important section from the bird point of view.

5. *Camp Area, Quarry and Railway.* Generally open grass, buildings and cultivation with a number of scattered trees. Included in this area some 20 acres of evergreen forest in which for anti-malarial reasons, the soil had been drained, and the undergrowth cleared and burnt, leaving the trees forming the canopy untouched. I call this the evergreen clearing.

6. *Meadow and Abandoned Cultivation.* A considerable expanse of plain at the western end of the area about half of which was open grazing land, meadow with short cropped grass and scattered trees, the rest a solid mass of Ageratum six or eight feet high among which remained a few sickly looking trees apparently half choked by the rampant weed.

In the detailed list of birds which follows, I have included notes as to the comparative status of identical or closely related species found in similar biotopes in S. India, but a few general observations may not be out of place here. I have pointed out above that the more humid climate in Assam gives rise to an admixture of evergreen and deciduous vegetation which rarely occurs in S. India where the vegetational zones are clearly marked and follow the lines of the isobars running north and south. There is a similar trend in the distribution of bird life. While the area under consideration conformed in the main to the characteristics of the S. Indian deciduous zone, a number of birds occurred which in the south are restricted to the evergreen rain forests. There were also a number of absentees which one would have expected to see. Too much notice cannot be taken of this as the area was such a small one.

Breeding. The breeding season of birds has no definite limits in tropical countries, but there is a maximum period, and in Assam it appears to be about a month later than in the south, i.e. April/May as against March/April. The casualties among the eggs and young of wild birds are always extremely high, but the figures I obtained for the nests which I found were positively catastrophic, and must surely have been exceptional. Of course there must have been ten nests in existence for every one which I found, but those I discovered were, I think, a fair average, and by no means always the most conspicuous. I was always careful to avoid disturbing the nest or the surroundings, and in no case was there a desertion as a result of my first visit. Other human interference could practically be ruled out, and there were very few crows or tree-pies about to spy on my goings and comings. One or two nests definitely succumbed to storms, a few others were smashed and pulled about, but in the vast majority of cases the eggs or young simply disappeared with very little disturbance of the nest. The fact that the area was inhabited by a pack of about twenty Langurs, another of Stump-tailer Macaques, and at least 3 pairs of Giant Squirrels may have had something to do with it. Having done no collecting, I refrain from using subspecific names.

1. **Corvus macrorhynchos.** *Jungle Crow.* Scarce. Only seen round the village, seldom in the forest. In Southern India they are found throughout deciduous forest even in the wildest parts, though thinly distributed. They are always the first on any carrion, and it is their appearance, probably, that summons the vultures.

2. **Dendrocitta vagabunda.** *Common Tree-Pie.* Occasionally seen in the camp area, apparently as casual visitors from cultivation. Not resident and never seen in the forest. In S. India they are equally at home in cultivation and deep in the deciduous jungles though not the evergreen.

[**Dendrocitta formosae.** Not seen. It might have been expected, being common enough in the Himalayan foothills. In S. India, the analogous *D. leucogastra,* while typically a bird of evergreen forest and never found in the purely deciduous biotope, is decidedly partial to the intermixed strip on the border of the two zones.]

[**Paridae.** Strangely enough no tits were encountered. In S. India *Machlolophus xanthogenys* would certainly have occurred in this sort of biotope with possibly *Parus major* though this is more of a dry zone bird.]

3. **Garrulax pectoralis.** *Black-gorgetted Laughing Thrush.*

4. **Garrulax monileger.** *Necklaced Laughing Thrush.* Both species occurred and except when seen together, so that the difference in size became apparent, they were almost impossible to tell apart in the field. A flock, often of the two species mixed, inhabited the boulder strewn eastern edge of the ridge both in deciduous and evergreen facies. Shy and not very noisy for Laughing Thrushes. They fed almost entirely on the ground turning over the drifts of dead leaves with a great deal of rustling and scratching. I have often expected to see some big bird like a pheasant or junglefowl from the noise that was being made. By the end of March they appeared to be paired and the flock broke up to a large extent. I found a nest of *G. pectoralis.* It was a large, rough, bulky cup of dead twigs and tendrils containing 4 bright blue unspotted eggs. The bird sat close but was extraordinarily adept at slipping off without giving a clear view and hiding in the undergrowth without a sign of her presence. Two pairs haunted this area and were extremely shy and silent at this time except in the evenings when they made a great noise while going to roost, one bird of a pair scolding and chattering, and being answered by its mate.

S. India. N.E. India being the real home of the Laughing Thrushes, it was natural to find them well represented in the Assam area. The sole S. Indian species (apart from *Trochalopteron cachinnans* which has a purely montane distribution and hardly enters the purview of this paper), *Garrulax delessertii,* is confined to the evergreen forest biotope and would not be met with in this intermediate type.

Argya and **Turdoides** ; Neither of these genera were seen. In S. India one would have expected *T. somervillei* in the Deciduous and Camp and Maidan sections, and probably *A. subrufa* in the secondary and thatch grass facies.

5. **Pomatorhinus (schisticeps?)** *Scimitar Babbler.* One or two pairs, sometimes small parties, usually were to be seen in evergreen facies, climbing about the trunks and branches of the trees and poking their long bills into crevices.

S. India : *P. horsfieldii* is quite similar to the above in habits.

6. **Alcippe inpalensis.** *Nepal Babbler.* Only seen in evergreen facies where it was not uncommon in pairs or small parties, feeding in the undergrowth or on the ground. A nest found on April 16th in dense forest was a foot from the ground in a young rattan palm where the fronds emerge from the brown, coir-like leaf spathes. It was a deep cup made of the loose, tattered bark on which it was built and was lined with black rhizomes. The three eggs were quite fresh, and indistinguishable from those of *A. poioicephala.* The sitting bird was very bold, leaving the nest reluctantly, and remaining close at hand with its mate, scolding angrily.

S. India : *A. poioicephala* is quite similar in habits and habitat. Its nests are usually made of moss.

7. **Pellorneum ruficeps.** *Spotted Babbler.* Seen in pairs and small parties all through the forested sections whether evergreen, deciduous or secondary. It was particularly fond of bamboo facies. A nest was found in a very typical situation on March 25th, containing 3 heavily incubated eggs. It was a ball of dead leaves very well hidden in a drift of dead leaves at the foot of a bamboo clump on the edge of a firepath. The parent, once the young were hatched, used to approach and leave the nest on foot, running through the undergrowth like a mouse. She provided mostly smallish insects, but on one occasion a cockroach of considerable size. The young left the nest on the 12th or 13th day from hatching.

S. India : The local subspecies is quite similar to the above in every way.

8. **Yuhina sp.** A pair were seen in deciduous forest on the hilltop, working through the undergrowth and low bushes.

9. **Aegithina tiphia.** *Iora.* Scarce. Seen once or twice in the Camp section, and in the thin deciduous forest on the crest of the ridge.

S. India : It would be likely to be common in this sort of biotope.

10. **Chloropsis aurifrons.** *Gold-fronted Chloropsis.*

11. **Chloropsis jerdoni.** *Jerdon's Chloropsis.*

Both species were fairly common in the secondary facies and in the camp area where they haunted large isolated mango trees. They were certain to be found at any time on *Bombax, Erythrina* and Asoka trees when these were in bloom.

12. **Chloropsis hardwickii.** *Orange-breasted Chloropsis.* More partial to the evergreen facies than the other two. It was seen feeding on the scarlet flowers of a strobilanthus-like plant in secondary facies, not more than four feet from the ground. This was unusually low, as all the Chloropses are birds of the treetops.

S. India : The first two species have much the same habits as in Assam, while the third does not occur.

13. **Molpastes cafer.** *Red-vented Bulbul.* Fairly common in the Camp and Maidan, usually in pairs. Rarely seen in the secondary facies and not at all in the forest.

S. India : The Assam bird looks much darker than the S. Indian and has definite whitish cheek patches which are not noticeable in the latter bird. Its status in comparison with *Otocompsa emeria* is much the same as in S. India. *M. cafer* occupies mainly the dryer and more open country, and *O. emeria* the wetter and more evergreen. Over much of their range they overlap and in an intermediate biotope with a bias towards evergreen such as one finds at Jagi Road, *O. emeria* is, as one would expect, dominant.

14. **Otocompsa emeria.** *Red-whiskered Bulbul.* Common throughout the Camp area, Maidan, secondary jungle and the borders of the deciduous, also on the

hilltop where the forest thinned out. It was not so conspicuously the commonest bird in the countryside as it usually is where it occurs in the South. As in the South however I found more nests of this bird than any other presumably because they are always easily accessible and usually not particularly well hidden, while the sitting bird takes no pains to conceal her departure. No nests seen before April 13th. Six nests were found between April 13 and 28. All were robbed before hatching. The full clutch in Assam appears to be 3 as against an average of two in S. India. In the South, breeding peak is reached a month earlier, usually by mid-March. In the field the Assam bird can be distinguished by the light coloured tips of the tail feathers, and the fact that the red cheek patches are so reduced as to be invisible at any distance.

15. **Otocompsa flaviventris.** *Black-crested Yellow Bulbul.* A forest Bulbul. It was most numerous in the secondary jungle but was also seen in the deciduous facies and also on the borders of the evergreen. It is an arboreal species seldom coming near the ground. A pair were seen collecting *Ageratum* seed down on April 11. A nest with two incubated eggs was found on April 26, seven feet up in a thick bush in shady but not very dense forest. It was a flimsy cup of dead yellow leaves bound with a little cobweb.

S. India: *Pycnonotus gularis* of S.W. India only differs from this bird in having a short hardly noticeable crest as compared with the long forward pointing crest of *O. flaviventris*, and a red throat patch lacking in the latter bird. Apart from this the two are nearly identical in habits, habitat, song, nest and eggs. They both have the peculiarity of making their nests very largely of yellow dead leaves. Judging from field study it looks very much as if we have here a bird which has developed, in the extremes of its range, differences that are undoubtedly of specific value but by no means such as to justify putting the two into separate genera, in company with other species not nearly so closely related. Unless there is some very good taxonomic reason against it, I suggest that *O. flaviventris* should be transferred to the genus *Pycnonotus*. Apart from the shape of its crest it has no near affinity whatever with *O. emeria*.

16. **Criniger gularis.** *White-throated Bulbul.* A few pairs were regularly but widely distributed through the evergreen facies to which they were entirely restricted. A very noisy bird, its note an ugly scolding, wheezy croak. They keep to the thick treetop canopy and are very shy and hard to see. A possible nest which, however, was deserted before eggs were laid, was found on April 10 in the undergrowth in thick forest. This bird has no S. Indian counterpart.

17. **Geokichla citrina.** *Orange-headed Ground Thrush.* A single bird was seen on two or three occasions feeding in the evening in the clearing in the evergreen jungle round the camp where the undergrowth had been cleared. It was shy and silent and like its South Indian congener, which has similar habits and habitat, it is probably a rains breeder.

18. **Turdus boulboul.** *Grey-winged Ouzel.* A single male was seen with fair regularity feeding on the ground in the open meadows at the western end of the area, and diving for cover into the *Ageratum* thickets when disturbed. There is no real southern representative. *T. simillimus* is a montane species which only appears in the deciduous zone occasionally in winter.

19. **Copsychus saularis.** *Magpie Robin.* Common and familiar as always. There were a number of pairs both in the secondary jungle and in the camp clearing to which they took very kindly. There was a tree just in front of my hut with a number of rotten, hollow branch stubs. These throughout April and May were continually being explored and fought over by a pair of Magpie Robins, a pair of Indian Rollers, and several Jungle Mynahs. I never discovered which if any finally set up house in them.

S. India: The Magpie Robin here is in every way similar.

20. **Kittacincla macroura.** *Shama.* Common in the secondary and deciduous biotope particularly in bamboo facies. A nest was found on April 22 with 4 eggs in an isolated stump in a clearing in the secondary jungle two feet from the ground. It was a cup of black rhizomes in the bottom of the hollow. The eggs hatched on April 23. Both parents fed the young on grubs or cater-

pillars of some kind. The young when last seen on May 2nd were in full quill and would have been due to fly in 3/4 days at most i.e. 12/13 days from hatching.

The Assam Shama struck me as being more numerous, tamer, and more ready to come into the open than its S. Indian congener. Furthermore, whereas the latter is a rather disappointing singer, letting fall five or six rich notes and then falling tantalizingly silent, in Assam they whistle freely for minutes together like the Magpie Robin.

21. **Myophonus temminckii.** *Whistling Thrush.* This was a surprising absentee. It is common all along the Himalayan foothills, and the rocky stream in the shady ravine in the southern border of the area was an eminently suitable habitat. Actually, though my wanderings took me considerably beyond the boundaries of the area under survey, I never saw it in the locality. In S. India though its congener *horsfieldii* is mainly a bird of the evergreen it is found in much drier country than Jagi Road given only a permanent, swift running hill stream with a border of evergreen vegetation along its banks.

22. **Enicurus schistaceus.** *Slaty-backed Forktail.* A pair frequented a 300/400 foot stretch of the stream bounding the area in the south, in very dark, heavy forest. Like Pied Wagtails in habits, they are never still, rarely if ever forsaking the stream bed, flying in a semicircle when driven to the limits of their territory and coming back to the stream behind one. They disappeared about April 30th. Migrated?

23. **Sitta castanea.** *Chesnut-bellied Nuthatch.* A pair were seen on two occasions in thin deciduous jungle. In S. India this is a bird of the drier parts of the deciduous zone only, and would hardly have been expected in an intermediate biotope like that of the Assam area.

24. **Siphia strophiata.** *Orange-gorgetted Flycatcher.* A single bird was seen in deciduous forest on the hill top on April 11th. It was probably on migration.

25. **Alseonax latirostris.** *Brown Flycatcher.* There were one or two pairs in bamboo facies. They were singing in early April and probably going to breed.

S. India: Found in similar bamboo country.

26. **Niltava macgrigoriae.** *Macgrigor's Niltava.* One or two pairs were seen in February and early March in the evergreen clearing and the adjacent evergreen forest. They disappeared later.

27. **Eumiyas thalassina.** *Verditer Flycatcher.* Seen at intervals in the Camp clearing up till March 10th presumably on passage.

28. **Hypothymis azurea.** *Black-naped Flycatcher.* Very common. It was quite the commonest flycatcher. Most numerous in secondary jungle and bamboo facies but occurring everywhere even in thick evergreen forest. A deserted nest was found on April 16th built on a loop of creeper hanging under a bamboo clump in secondary forest.

S. India: Quite similar here but not nearly so common.

29. **Rhipidura albicollis.** *White-throated Fantail Flycatcher.* A single bird was seen for a day or two at the end of February in the evergreen clearing.

S. India: *R. aureola* is strictly a bird of dry deciduous biotope and would hardly have been expected in this sort of intermediate zone.

30. **Notodela leucura.** *White-tailed Blue Robin.* Once seen in thick undergrowth in thick evergreen forest.

31. **Calliope pectoralis.** *Eastern Ruby-throat.* Once seen in March in *Ageratum* scrub. **Lanius** spp. *Shrikes.* No true shrikes were seen which was very surprising. One would have at least expected *L. nigriceps* which is so common over most of Assam. In S. India the meadow land and *Ageratum* scrub would have provided an ideal habitat for *L. schach* at all times and *L. cristatus* in winter.

32. **Hemipus picatus.** *Brown-backed Pied Shrike.* Not common. A few pairs were distributed through the area mostly in deciduous forest. A pair were seen building a nest on March 24th in a typical site 20 feet up on the upper surface of a thin horizontal bough of a leafless tree standing by itself on a firepath on the hilltop in thin deciduous jungle. Both birds were bringing cobwebs. They began sitting extremely tightly on April 2 and continued to do so for a week until the bough on which the nest was built was broken off one night in a storm. The nest was as usual a minute cup of lichen bound thickly with cobweb to the upper surface of the branch where it appeared as a scarcely discernible excrescence.

S. India : The local subspecies is quite similar in habits and distribution.

33. **Tephrodornis gularis.** *Large Wood-shrike.* A flock was generally to be seen in the deciduous jungle on the hilltop, sometimes coming down into the quarry. I saw one building a nest on April 18 in a bare outlying horizontal fork, 20 feet up in a leafless tree on the hilltop. It was bringing cobwebs. As usual the nest was built on top of the bough, where it broadened out at the point of division, so that very little was discernible from below. Ten days later the bird was sitting, brooding with the head back and bill pointing vertically upwards, so still that it might have been in a trance. With its grey plumage it looked just like a broken stub of the tree itself.

S. India : *T. g. sylvicola* is found in similar biotope but in much greater numbers.

34. **Pericrocotus speciosus.** *Scarlet Minivet.* Seen on several occasions in small flocks in deciduous jungle but was by no means common. The Southern Indian *P. flammeus* would be definitely common in country of this type.

35. **Chaptia aenea.** *Bronzed Drongo.* Very scarce. Seen on two occasions in secondary jungle.

S. India : It is very common indeed in this sort of intermediate forest biotope.

36. **Chibia hottentota.** *Hair-crested Drongo.* The typical drongo of the area, in fact the only one which could be said to be common. It occurred freely all through the deciduous forest, secondary jungle, Camp and Maidan sections. Any flowering tree was certain to have half a dozen on it feeding on the nectar and on one occasion I saw seven or eight feeding among the blossoms of a shrub with scarlet flowers growing 6/7 feet high in a secondary clearing. This species appears to be the typical drongo over much of Assam in light forest or well-wooded cultivation. It is bold and familiar and lives and breeds in tea gardens where there is a good growth of shade. It is interesting to note that the relative status of this species and *Dissemurus paradiseus* in Assam is quite reversed in S. India. In the latter part of the country, the local subspecies of *C. hottentotta,* which even in the field is noticeably smaller than the Assam bird, is scarce and erratically distributed. They appear to wander widely, a few turning up when any of their favourite trees are in bloom, and then disappearing again. They are always shy and hard to approach. *Dissemurus paradiseus* on the other hand is common all through the moister deciduous and intermediate zones especially in bamboo facies and well-wooded cultivation in the neighbourhood of bamboo jungle. It is one of the typical birds of the shady coffee and cardamom plantations.

37. **Dissemurus paradiseus.** *Large Racket-tailed Drongo.*

A couple of pairs had territories in the deciduous jungle on the hillside where there was a fair growth of bamboo. They were much shyer than their S. Indian congeners, and I never saw them except in fairly thick forest. Like the latter, however, they were extremely noisy birds and great mimics.

38. **Bhringa remifer.** *Lesser Racket-tailed Drongo.* A single bird was seen for about a week always in the same spot on the borders of the evergreen and secondary facies. It was silent and extremely shy and unlike most drongos did not choose some bare outstanding bough on which to perch, but kept very much to the interior of tall leafy trees, so that one only saw it when on the wing. In this species the rackets are formed by equal vanes on either side of the quill,

whereas in *Dissemurus* the rackets are altogether on the outside[1] of the quill, the inner vanes being rudimentary.

39. **Phylloscopus** sp. *Willow Warbler.* Several species occurred but apparently only as winter visitors.

40. **Orthotomus sutorius.** *Tailor Bird.* Occurred in the open weedy clearings in secondary forest.

41. **Irena puella.** *Fairy Bluebird.* Seen on occasions in pairs in the evergreen facies. None appeared to be permanently resident within the area.
S. India : The bird here is quite similar and is a good deal commoner in the sort of jungle found at Jagi Road, than it was in Assam.

42. **Oriolus xanthornus.** *Black-headed Oriole.* Seen all through the Camp area and deciduous forest at various times. By the end of March a pair had settled down in a comparatively restricted territory in the thin open woodland at the top of the hill, where they evidently intended to breed, but I did not succeed in finding a nest and do not think incubation can have started up till the time I left on May 7th, as both birds were still about. I saw them feeding on berries and on two occasions on large hairy *Bombycid* caterpillars. These were beaten on a branch for at least ten minutes before being swallowed, presumably to remove the stinging hairs.
S. India : Here this species is confined to dry purely deciduous country. *O. oriolus* which is common in moist deciduous and intermediate evergreen facies in S. India as a winter visitor, was not seen in Assam.

43. **Gracula religiosa.** *Grackle.* Fairly common in noisy flocks of up to a dozen, usually in the deciduous forest. There were 3 or 4 enormous *Bombax* trees on the hillside whose straight boles, running up fifty feet without a branch were riddled with the grackles nest holes, the work of several seasons. Two or three pairs were nearly always to be seen of an evening, volubly discussing the day's affairs in the upper branches of these trees. The holes are quite distinctive, oval in shape and untidily finished off, the edges being chewed and blurred, not clean cut like a woodpecker or barbet's work.
S. India. The local bird is quite similar in habitat and behaviour.

44. **Sturnia malabarica.** *Grey-headed Mynah.* Quite common in the Maidan and *Ageratum* scrub area where by the end of April they were breeding in holes in the scattered trees. I never saw them in any of the forested sections.
S. India : *S. m. blythii* while equally common in parkland and wooded cultivation is also found freely in light open deciduous forest.

45. **Acridotheres tristis.** *Common Mynah.*

46. **Aethiopsar fuscus.** *Jungle Mynah.* Both species occurred in the Camp area, Maidan, and round the village, but not in the forest, either deciduous or evergreen. Both were breeding by mid April in holes in trees round and in the Camp. While in the area I have demarcated, both species co-existed, *A. fuscus* never extended its range very far from the foot of the wooded hills, and as soon as one got out into the open grass plains north of the Trunk Road, *A. tristis* held the field alone. From the field naturalist's point of view it seems absurd to place two species so similar in different genera.
S. India : Here the comparative distribution is much the same as in Assam. *A. tristis* is always to a greater extent commensal with man. While it may be found in dry deciduous jungle well away from cultivation, in the wetter areas it is strictly confined to the neighbourhood of habitations.

47. **Sturnopastor contra.** *Pied Mynah.* Quite common in the Maidan section and the more open, grassy portions of the Camp area. Sure to be found where cattle were grazing. They were nest building by the second week of April.

48. **Saroglossa spiloptera.** *Spotted-winged Stare.* A large flock spent a couple of days feeding on the blossoms of a big Asoka tree on the hilltop. This was

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[1] Only *apparently* on the outside, but actually *inside*, a twist in the shaft producing the illusion. EDS.

the only time they were seen, with the exception of a solitary bird a few days later on a flowering *Erythrina* in the quarry. They were noisy, chattering birds highly social and typically Starlings.

49. **Uroloncha striata.** *White-backed Munia.* Seen regularly in pairs and small parties in the secondary jungle. Found several empty nests from March 19 onwards. These were evidently used for roosting purposes as I flushed 3 or 4 birds out of one nest on more than one occasion, and the nest had definitely not been used for breeding.

S. India: The bird here is quite similar in every way.

50. **Uroloncha punctulata.** *Spotted Munia.* Only once encountered when flushed a large flock of 50 or more out of some bushes on the edge of the secondary jungle.

S. India: Common in similar country.

51. **Ploceus passerinus.** *Weaver Bird.* I saw a flock on March 28th in non-breeding plumage, feeding among the flowers of a blossoming Asoka tree in the deciduous section, well inside the forest, not at all where one would expect Weavers. They were there in the same place on April 18, one male in breeding plumage. On May 5th, probably the same flock had started building at the top of a 40 foot tree on the edge of the secondary jungle where it bordered on the thatch grass patch. Five nests were in progress, thatch grass being the material used. Near by though not actually in the area, a colony were building on the roadside telegraph wires, a site I have never seen used in S. India though it seems not uncommon in this part of Assam.

S. India: I have never seen Weavers actually in forest in S. India though they are common enough on the outskirts both in deciduous and intermediate biotopes wherever there are paddy fields. There their breeding season is determined largely by the paddy cultivation. They use strips of paddy leaves almost exclusively for nesting material, and seldom begin work before June when the crops are a foot or more high.

52. **Passer domesticus.** *House Sparrow.* A number lived round the quarry workers' huts. Purely commensal with man.

53. **Hirundo daurica.** *Red-rumped Swallow.* The only swallow definitely identified. It was quite numerous in the open parts of the area—Camp, Quarry and Maidan. A pair was seen collecting mud from a puddle on the main road in mid-April but I did not find the nest.

S. India: Here, on the whole, a bird of dry deciduous country.

54. **Motacilla citreola.** *Yellow-headed Wagtail.* Two or three frequented the Maidan pastures for a few days from April 14th, evidently on passage. They were in full breeding plumage.

55. **Cinnyris asiatica.** *Purple Sunbird.* I did not see any until the end of March when they became common in the open parts of the area, and in thin deciduous forest. A nest with young in the quill was found in the quarry on April 13th. On April 18th this had been half destroyed, probably after the young had flown, and a female presumably the owner was removing the materials to a new site a couple of hundred yards away.

56. **Aethopyga siparaja.** *Yellow-backed Sunbird.* Not numerous but regularly to be met with in cultivation and the waste land sections overgrown with *Ageratum*.

57. **Aethopyga gouldiae?** *Manipur Yellow-backed Sunbird.* I believe I saw this once in the secondary jungle. It was rather a quiet, unobtrusive little bird, flitting about in the interior of bushes and not so active on the wing as most of its kind.

58. **Dicaeum cruentatum.** *Crimson-backed Flowerpecker.* One pair seen in cultivated land. These were the only flowerpeckers noticed which was surprising

as there were plenty of parasites of the *Viscum* and *Loranthus* families. In S. India one would expect to find *D. erythrorhynchos* common in such biotope.

59. **Arachnothera magna.** *Streaked Spider-hunter.* Probably a good deal commoner than one realised but owing to its swift flight, cryptic coloration, and preference for the canopy of tall trees in evergreen forest, it was difficult to see. A nest which I believed to have been of this species was found in process of construction on March 30 in a sapling growing in a cleft between two huge boulders in thick shady forest. It was completed and the full clutch of 4 eggs laid on April 11th. It looked like a huge and very ragged sunbird's nest without the usual cobweb binding, being composed of dried grass and bark shavings which looked as if they had been robbed from a tree rat's home. There was a lining of bamboo leaves. The bird was shy and I was never able actually to identify her on the nest which she left like a streak of lightning on one's approach, but there was always a Spider-hunter near by making much noise and demonstration at a safe distance. On April 26th the nest was found on the ground with two eggs still intact. There had been several very heavy storms and it looked as if it had got soaked, and, being very loosely and roughly suspended from the tip of a twig, had pulled away from its foundation and collapsed with its own weight. The nest was about 15 inches long, of which the straggling tail of rubbish hanging below took up a good third, by six inches at the widest. This type of nest appears to be more like that of a Broadbill than the normal Spider-hunter pattern. But the bird that flew off was definitely not a Broadbill. The eggs were whitish fairly heavily spotted with greenish brown especially at the big end but not so heavily as to conceal the ground colour.

60. **Pitta cyanea.** *Blue Pitta.* This was seen on several occasions on the ground in thick undergrowth in evergreen forest. I found what I believe to have been a nest of this species at the end of April, though I never actually saw a bird visit it. It was a large round structure the shape of a football, over a foot in diameter with a four inch wide entrance on one side, substantially constructed of sticks and dead leaves, and placed on the top of a foot high tree stump in the middle of a bed of broadleaved, canna-like plants, under the shade of evergreen forest. On April 30th it was being lined with bamboo leaves and rhizomes, but two days later it appeared to have been disturbed and eggs were never laid.

61. **Pitta nipalensis?** *Blue-naped Pitta.* A bird believed to have been this species was observed on several occasions feeding late in the evening in the evergreen clearing on the forest edge. It was extremely shy and would run back into the jungle as soon as it saw one coming, and it was usually too dark to get a really good view. It was a typical Pitta in shape and action, with the characteristic long legs and almost complete absence of tail.

S. India : *P. brachyura* is a fairly common winter visitor but does not breed.

62. **Serilophus rubropygius.** *Hodgson's Broadbill.* A pair were seen in evergreen forest on April 26th. They were quiet, rather sluggish birds, keeping to the treetops, perching very erect and the tail kept well down and frequently twitched.

63. **Picus canus.** *Black-faced Green Woodpecker.* Occurred regularly in pairs and small parties, mainly in evergreen but also in deciduous forest. I flushed birds from nesting holes on April 14 and 16 in both cases in small trees in thick evergreen forest and low down. One of the holes was not more than 18 inches above ground level, the lowest woodpecker hole I have ever seen. Both appeared to be old borings used a second time. From the second hole I flushed both male and female at different times.

64. **Picus chlorolophus.** *Lesser Yellow-naped Woodpecker.* Not so numerous as the last but fairly often seen in evergreen forest. It occurs in similar biotopes in S. India.

65. **Chrysocolaptes guttacristatus.** *Tickell's Golden-backed Woodpecker.* A family party seen on one or two occasions in deciduous forest. Much the same habits as the S. Indian bird and with a similar call.

66. **Gecinulus grantia.** *Pale-headed Woodpecker.* A striking little woodpecker. A pair was seen on several evenings about 9th to 14th. March in bamboo facies of the deciduous forest, and in the neighbouring, more open secondary jungle. They were very active, running up and down the bamboos constantly calling each other with a peculiar chattering call, flapping their wings as they did so. In shape and posture they resembled *Micropternus brachyurus.*

67. **Hypopicus hyperythrus.** *Rufous-bellied Woodpecker.* Seen on one or two occasions among the scattered trees of the maidan section of the area.

68. **Sasia ochracea.** *Rufous Piculet.* This pretty little bird was seen on a number of occasions in secondary jungle and bamboo clumps in the deciduous forest, usually quite low down. Almost invariably solitary. An active little creature, very tit-like in its ways.

69. **Picumnus innominatus.** *Spotted Piculet.* Very similar to the last in habits and habitat but a good deal more common.

S. India: This is the only piculet which occurs and it is rare. It is found in the same sort of biotope, but ascends the hills to 5000 feet.

70. **Thereiceryx lineatus.** *Lineated Barbet.* There were a fair number in the open parts of the area, the Camp zone and Maidan with their scattered trees, and also less often, in secondary forest, though rarely if ever in the big forest.

S. India: The analogous species *T. viridis* is far commoner than the above in this sort of biotope; in fact it is about the commonest bird.

71. **Cyanops asiatica.** *Blue-throated Barbet.* Much commoner than the last, widely distributed all through the deciduous forest and secondary jungle. I watched one digging out a nesthole on April 11th in a dead bough. It pecked with open beak, biting and wrenching out chunks of wood. At intervals it would pause to utter it's—'*bring, bring, bring*'. As it called the air pouches on the sides of the throat could be seen dilating.

72. **Xantholaema haemacephala.** *Coppersmith.* This was rather scarce. It was usually seen in the secondary jungle where it kept to the tops of high trees. Not nearly as common as *X. malabarica* would be in similar biotope in S. India. There *X. haemacephala* is a bird of very dry deciduous country.

73. **Surniculus lugubris.** *Drongo Cuckoo.* A regular frequenter of the secondary jungle and the evergreen clearing. It was very like a small drongo in colour, shape and flight, but the bill was noticeably cuculine and it was sluggish and lacked the brisk activity of the king crows. It was usually seen solitary on a leafless bough at the top of a tree. A noisy bird with a whistle of five piping notes on a rising scale, and occasionally another call rather like that of the Plaintive Cuckoo. Although recorded from S. India, it is definitely rare there, and I have never come across it.

74. **Penthoceryx sonneratii.** *Banded Bay Cuckoo.* Once seen in secondary forest.

S. India: The commonest of the small cuckoos in this sort of biotope, foisting its eggs on the Iora principally.

75. **Chalcites maculatus.** *Emerald Cuckoo.* A pair of these delightful little birds lived in the secondary forest. They were usually to be seen on bare or lightly foliaged trees. They were unusually active for members of the cuckoo tribe, with a brisk, decisive flight, as they constantly flitted from bough to bough or flew out to take insects on the wing. They had a characteristic perching attitude, a crouch, often along, instead of across a bough, the long wings when folded extending beyond the tail tips. The note was a constantly uttered trill, not unlike that of the Loriquet, which bird they indeed resembled in size and flight.

76. **Rhopodytes tristis.** *Green-billed Malkoha.* Three or four pairs were scattered through the secondary jungle, the thin deciduous jungle on the hilltop, and the border of the Maidan. They were sluggish birds usually seen in pairs, spending most of their time sitting in some thick-foliaged shrub or sapling of no great height. I never saw one feeding. The note was a low croaking '*ko, ko, ko*'. On April 18 I flushed one from a small isolated tree, 10 feet high, smothered in creepers on the edge of a fire line, and found a nest there in the heart of the tangled mass. It was a ridiculous little cup for so large a bird, made simply by interlacing and twining the surrounding and still green and living and unbroken leaves and tendrils. There was one fresh egg which was robbed by some creature the next day.

S. India: *R. viridirostris,* a smaller species of much the same habits occurs in similar biotope with a tendency towards dry, deciduous scrub jungle.

77. **Centropus sinensis.** *Common Crow-Pheasant.* There appeared to be only two pairs in the area, one living in the secondary jungle and the thatch grass patch adjoining, and the other in the Maidan and the neighbouring *Ageratum* thickets. The latter pair used to come out of an evening and feed in the open meadow, often in the company of the local junglefowl flock. They seemed a good deal shyer and less noisy than in S. India, where they are very common both in deciduous and evergreen country, avoiding only the extremes of dense, continuous forest and bare, treeless plains.

78. **Centropus bengalensis.** *Lesser Crow-Pheasant.* At least one pair lived in the thatchgrass patch and the secondary scrub and forest adjoining, but they were seldom seen, skulking in the thickest cover and only visible on the rare occasions when they took wing. They seem common in grass throughout Assam. In S. India exceedingly scarce.

79. **Psittacula krameri.** *Rose-ringed Paroquet.* Not at all numerous and great wanderers. Seen in small parties in the deciduous jungle or more frequently flying over the area in the evening on their way to roost. Very much forest birds here.

S. India: In this biotope one would have expected to find *P. cyanocephala* and *P. columboides* common.

[Loriquet *Coryllis vernalis.* Never seen here which was surprising as in S. India it is exceedingly common in similar biotope.]

80. **Coracias benghalensis.** *Common Roller.* Two pairs inhabited the Camp area and at least two more the Maidan. Their territories were large, each pair holding sway over not less than 10/15 acres. They were evidently going to breed in the area, but I never actually discovered a nest. As stated elsewhere a good deal of quarrelling went on between the robbers, Mynahs and Magpie-Robins over possibly suitable hollows in the scattered trees in the Camp. In S. India this is a bird of the plains and dry open deciduous jungle. It is scarce in the wetter parts of the deciduous belt and is not found at all in the evergreen country.

81. **Eurystomus orientalis.** *Broad-billed Roller.* At least two pairs frequented the area. One of these was usually to be seen among the scattered trees of the secondary jungle and the neighbouring deciduous forest-covered hillside. The other pair lived at the opposite end of the area in the Maidan, and the mixed forest on its borders. The wings are more pointed and the flight more darting and rapid than in the case of the Common Roller. Unlike that species they hardly ever came to the ground, frequenting the tops of tall leafless trees, and flying out to catch insects on the wing. On March 10th I saw a pair apparently courting. They perched side by side, making a great noise, a chattering croak. As they called both birds would nod their heads slowly up and down and at intervals one or other would swoop down to a grackle's hole, one of many bored in the trunk of a tall Simul tree about 40 feet up, pause clinging to the entrance a second or two, and fly up again.

S. India: Here this bird is rare and apparently confined to evergreen forest in the extreme S.W. i.e. Travancore. It has not been noted as far north as Coorg or Mysore.

82. **Merops superciliosus.** *Blue-tailed Bee-eater.* One or two small parties were seen on several occasions on the Maidan. They appeared to be on passage and not resident.

S. India: Only found in the dry, arid plains of central Mysore. Does not occur in forest.

83. **Alcemerops athertoni.** *Blue-bearded Bee-eater.* A pair were usually to be seen in the spindly, thin deciduous jungle on the hilltop, especially on the borders of the outcrops of bare rock. As in S. India where they are found in similar biotope but are not nearly so common, they are rather silent, sluggish birds, their note a low croak. On one occasion I saw a pair feeding on nectar on a flowering *Erythrina* tree. While some breed in April/May, the principal season is undoubtedly October. At this time one comes upon their newly bored holes every mile or so in the banks of the bridle paths all through the Assam hill tracts.

[Kingfishers: None were seen.]

84. **Anthracoceros malabaricus.** *Large Indian Pied Hornbill.* A flock of about ten were the most striking avian inhabitants of the area. They frequented all parts of the deciduous and evergreen biotopes and ranged a good deal beyond its borders, but they were nearly always to be seen at some time of the day within its limits. In the evenings at sunset, just before going to roost they used to come down regularly to one or other of the big termite hills scattered about the open grass of the Maidan, and make a light supper on the termites emerging for their night's work, often in company with a junglefowl or two. Their antics were most amusing as their enormous bills were very ill adapted for dealing with such small prey. By the end of February they were beginning to pair, the cocks chasing the hens, and the courting couples perching side by side caressing and cuddling each other. By mid-March though still to be seen in a loose, noisy flock, they were evidently fully paired off. During April the flock broke up and the birds were seen much less though up to the end of the month one still saw occasional pairs so it did not look as though incubation had begun. I did not succeed in finding a nest and fancy they retire further into the forest to breed.

S. India: Confined to heavy evergreen forest on the Ghats.

85. **Harpactes erythrocephalus.** *Red-headed Trogon.*

Scarce, seen once or twice, solitary in evergreen forest. A silent, sluggish bird, spending most of its time sitting very erect on a bough, occasionally flitting out after an insect. Quite similar to the S. Indian *H. fasciatus* in habits and habitat.

86. **Huhua nipalensis.** *Forest Eagle Owl.* A large horned owl which I believe to have been this species was flushed on several occasions from thick foliaged trees in the evergreen forest.

87. **Astur trivirgatus.** *Crested Goshawk.* A pair lived in the area, mostly in evergreen jungle though they were shy and seldom seen. Their nest was found on March 12th, 25 feet up in the top of a creeper-overgrown tree in thin forest in a swamp. It was a substantial platform of stout twigs, eighteen inches wide, which appeared to have been constructed entirely by the birds themselves. There was a deep cup lined with leaves now dry, but apparently green when first brought. There were no eggs. The bird was seen near the nest on several occasions subsequently, but only on March 18 was she seen sitting. On March 21 I flushed her from the nest. Unaware of her departure her mate flew up just then with something in his claws, saw me and beat a hasty retreat. There were now two eggs, round and bluish-white with a few blood smears. The bird flew round while I was climbing and made one or two feints at me but did not actually attempt to attack. A few days later the nest was deserted for some reason, and the birds were not seen again except on one occasion. A pair of junglefowl were heard calling hysterically in the secondary jungle not far from the deserted nest. On going to see what was the matter, I flushed one of the Goshawks from the ground. It carried nothing away, nor was there any sign

of its having struck anything on the ground. I can only imagine that the junglefowl had chicks and that the hawk had made an abortive stoop on them and was searching for where they had hidden themselves.

S. India: Occurs in similar biotope and I have found the nest in much the same situation. Very much a forest hawk, hiding in thick trees and relying on a sudden, swift, short stoop to capture its prey.

88. **Accipiter virgatus.** *Besra Sparrow-hawk.* Hearing a great commotion of small birds one day in an evergreen ravine, I flushed a Besra carrying some bird almost as big as itself which it had just killed. I could not identify the prey but believe it was a Laughing Thrush of some kind.

89. **Haliastur indus.** *Brahminy Kite.*

90. **Milvus migrans.** *Pariah Kite.*

91. **Pseudogyps bengalensis.** *White-backed Vulture.*

92. **Sarcogyps calvus.** *Pondicherry Vulture.*

While they can hardly be classed as residents all these scavengers were to be seen at various times in or above the area. The Brahminy Kite was the most uncommon and the White-backed Vulture the most numerous. Vultures of both species were often to be seen resting on tall trees on the hill and probably roosted there. *P. bengalensis* was breeding in Feb. in large numbers in big peepul trees round the railway station and the bazaar outside the area limits.

93. **Sphenocercus apicaudus.** *Pintailed Green Pigeon.* A small flock was seen on one occasion on April 27 on a fruiting banyan tree in deciduous forest.

94. **Dendrophassa pompadora.** *Ashy-headed Green Pigeon.* None were seen until the last week in April when vast numbers, flocks of 100 or more gathered to feed on a certain smooth green fruit, the size of an olive, growing on a clump of trees in a ravine. On April 29th, a nest was found in an apparently most unsuitable spot. It was a fairly substantial twig platform in a main fork, 40 feet up in a completely bare tree right out in the middle of the Maidan. The sitting bird was ludicrously conspicuous and the tree an obvious perching place for every hawk, owl, and crow in the neighbourhood. True there was a drongo's nest in process of construction on another branch of the same tree which might have provided some protection but one would have expected the pigeon to choose some leafy evergreen where its colour would give it perfect camouflage. It was rather interesting to find breeding going on while the species was flocking so intensively in the neighbourhood. It rather suggests that the birds lead a perennially nomadic and highly social existence, breeding taking place wherever a suitably large and long term source of food supply exists.

S. India: The Southern subspecies is the typical green pigeon of this sort of intermediate biotope. *Crocopus phoenicopterus* occurs in dry deciduous country and the Imperial (*Ducula badia*) is found on the higher hills and in the evergreen forests.

95. **Chalcophaps indica.** *Emerald Dove.* Fairly common in the evergreen forest especially on the edges of clearings and firepaths where it could feed on the ground. It was shy and more often heard than seen. It is quite similar in habits and habitat in S. India. Definitely a bird of the evergreen forests, but wandering into the intermediate zone on the borders.

96. **Macropygia unchall.** *Bar-tailed Cuckoo-Dove.* Confined to the evergreen forest where it was a good deal commoner than the last. Appeared to be exclusively frugivorous, rarely if ever coming to the ground. It was usually solitary or in pairs, except for a few days at the end of April when numbers foregathered with scores of green pigeon to feed on a certain fruit. Even then they behaved independently and not as a flock.

97. **Streptopelia chinensis.** *Spotted Dove.* Exceedingly common everywhere except in the evergreen forest. As in similar biotope in S. India, it was much the commonest of the pigeon family and indeed one of the most numerous of any species of bird.

98. **Gallus bankiva.** *Red Junglefowl.* Common throughout the area in evergreen and deciduous forest. A flock of about a dozen used to feed every evening in the meadows of the Maidan, emerging from the jungle about 4 p.m. and retiring again at dusk, when they went to roost in the bamboos. Oddly enough cocks in full plumage were in the majority, the proportion of cocks to hens being about 7-5 at any rate up to the end of March, and there seemed little sign of breeding or rivalry among the males. During April however the flock broke up and the birds apparently distributed themselves in pairs throughout the deciduous and secondary biotopes. Morning and evening the jungle would sound like a barnyard as cock shrilly challenged cock. As mentioned previously, an odd bird would often join the hornbills in their evening snack of termites on the anthills in the Maidan.

S. India : *G. sonneratii* is very similar in habits but is not so gregarious and is rarely if ever seen in flocks.

99. **Polyplectron bicalcaratum.** *Peacock Pheasant.* Two cocks of this interesting species lived in the area. They each owned a restricted territory in the bamboo facies of the deciduous jungle on the borders of the secondary belt. They lived about 500 yards apart and their favourite feeding grounds were the clear leafstrewn spaces beneath the clumps of giant bamboos. They were exceedingly shy and wary, never coming out into the open, but they gave themselves away by their vocal efforts. Every evening the two birds would mount some fallen log, boulder, or low tree, and crow loudly for five or ten minutes together, each answering the other. There was usually one period of crowing about 5 p.m. and another at dusk when they went to roost. If they realised that there was a human in the neighbourhood, they would at once fall silent, hop down, and slip away into the undergrowth. I frequently stalked the birds when they were calling but never saw any females in the vicinity, though on one occasion, just before roosting, the male was accompanied by two hens as he fed through the low bushes. One of the cocks used to roost regularly by himself on a low bush beneath a bamboo clump, and returned to the same spot in spite of my having shot unsuccessfully at him with a revolver at 5 yards range only the previous night. The territories seemed very restricted extending little more than a couple of hundred yards round the bamboo clumps which formed their headquarters.

100. **Gennaeus horsfieldii.** *Black-breasted Kalij.* Not as numerous as the junglefowl but there were at least four or five cocks with their respective harems distributed through the area, both in evergreen and deciduous forest. One cock and two hens used to feed regularly on the Maidan in the evenings in company with the junglefowl flock. From mid-Feb. to mid-April, one invariably saw a cock with at least two and sometimes three hens in attendance. After that I have seen solitary cocks, and breeding had presumably commenced. They were rather silent birds, and the bubbling crow of the cock was by no means a frequent sound.

101. **Gorsakius melanolophus.** *Malay Bittern.* A single Bittern haunted the swampy forest at the east end of the area throughout March and April. It spent much of its time perched in some thick foliaged tree, feeding in the bog below when so inclined, and, on being disturbed flapping off to another tree a few yards away. I never heard it utter a sound, nor was it ever seen away from this restricted area of forest swamp.

102. **Leptoptilus javanicus.** *Lesser Adjutant.* Could hardly be classed as a resident as their feeding grounds were in the paddy fields and thatch grass 'bhils' north of the Trunk Road. Very often of an evening 4 or 5 of these stately birds would be seen perched on one or other of the giant simul trees on the hillside, sun bathing and drowsing after the day's work.

ANALYSIS OF BREEDING ACTIVITIES

Species	*No. of Nests No. in Clutch*	*Date found*	*Result*	*Remarks*
Garrulax pectoralis ...	1–c5	15.iii	Robbed 20.iii	Full clutch 15.iii.
Pellorneum ruficeps...	1–c3	28.iii	Successful ...	Full clutch 28.iii. 2 Chicks hatched, one egg addled, on 28.iii. Chicks flew on 10.iv, 13 days from hatching.
Alcippe nipalensis ...	1–c3	16.iv	Robbed ...	Full clutch fresh eggs 16.iv, robbed 25.iv.
Otocompsa emeria ...	6–c3, 1, 2, 3, 2	13.iv 30.iv	All robbed...	No incubated clutch under three in no.
Otocompsa flaviventris.	1–c2	26.iv	Robbed ...	26.iv Incubated. 30.iv Robbed.
Kittacincla macroura...	1–c4	20.iv	Successful ...	Hatched 23.iv. Flew 6/7.v. 11/12 days from hatching.
Hemipus picatus ...	1–c?	24.iii	Blown down in storm.	Building 24.iii. Sitting 2.iv. Destroyed 11.iv.
Tephrodornis gularis...	1–c?	18.iv	Success up till last seen.	Building 18.iv. Sitting 28.iv.
Sturnopastor contra ...	2–c?	13.iv	?	Building 9.iv.
Ploceus passerinus ...	5–c?	...	?	Building started c. 28.iv.
Uroloncha striata ...	3	...	...	In occupation 19/25 March. No eggs ever seen. Possibly only roosting nests.
Arachnothera magna ?..	1–c4	9.iv	Blown down in storm.	Building 9.iv. Full Clutch 14.iv. Destroyed 26.iv.
Cinnyris zeylonica ...	1–c2	13.iv	Successful ?	Well grown young 13.iv. Nest being dismantled 18.iv.
Pitta cyanea ...	1	26.iv	Deserted before laying.	Building 26.iv. Lining 30.iv. Deserted 2.v.
Picus canus ...	2–c ?	14.iv	?	Sitting when found .

ANALYSIS OF BREEDING ACTIVITIES—(*Continued*)

Species	*No. of Nests No. in Clutch*	*Date found*	*Result*	*Remarks*
Rhopodytes tristis ...	1–c1	18.iv	Robbed ...	18.iv Fresh egg. 22.iv Robbed.
Astur trivirgatus ...	1–c2	14.iii	Deserted ...	14.iii Ready for eggs. 21.iii Sitting 2 eggs. 1.iv Deserted.
Dendrophassa pompadora.	1–c?	29.iv	Success while observed.	29.iv Sitting.

OBSERVATIONS ON THE BIOLOGY OF *APHIS NERII* (FONSC.)

BY

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Morphology

This species is easily recognised by the deep yellow colour of the body with cornicles, cauda and anal plate black. The antennae extend beyond the cornicles. The joints of the legs are black. The tip of femur is shaded fuscous both in the alate and apterous forms but not in immature ones. Thoracic terga are dull grey in alate forms. The antennae are uniformly black in alate forms but are not so in apterous ones. 9 to 12 equal-sized sensoria lie in one line on article III of the antennae of alate forms. The red eyes of the immature young can be seen through the skin of the abdomen of the adult apterous females. A waxy yellow liquid is exuded through the siphons, which on exposure to air rapidly becomes coagulated. The body turns brown in colour when dead. The morphological details of the aphid under report are given at the end of the paper under caption 'Measurements'.

Distribution

The species is practically cosmopolitan in distribution. In India, this aphid species has been reported from Lahore (Das, 1918), Delhi, Rohtak, Karnal (Deshpande, 1937), Coimbatore, Bellary (George, 1927) and Mysore (Krishnamurty, 1928). Goot (1917) gives a list of specimens of aphids in the collection of the Indian Museum and mentions therein that this species occurs in Calcutta as well as in Barakuda Islands (Orissa).

Host Plant.—Das (1918) reports this species of aphid from a number of plants and George (1927) mentions that *Daemia* plants are likewise host plants. Goot (1917) records its occurrence on *Tylophora asthmatica W & A.* Here in our college garden at Ballygunge, Calcutta and near about this locality, we find this species clustering on the leaves especially on the veins of the abaxial and adaxial sides, as well as on the leaf stalks, stems, flower stalks and on the fruits of *Calotropis gigantea* R. Br., which is locally called the akanda.

This pest is harmful to the host plant since it occurs in great numbers and causes heavy loss of sap. The leaves of the plant become shrivelled and turn yellow in colour and ultimately wither away. The leaves get covered with honey-dew excretions of the insect encouraging fungus-growth.

Seasonal Occurrence.—Both alate and apterous forms of this insect were most abundant during the cold months of December 1944 and January 1945. The apterous forms only, however occasionally were seen as late as the hot months of May, 1945. They disappeared in June, July and August 1945. Both forms, however, began to reappear towards the last week of September and became very abundant again in December. They were markedly absent during the rainy season.

It is remarkable to note that no sexual forms (male) appeared among the lot under our observation. The alate forms as compared to the apterous ones were fewer in number. Apterous parthenogenetic forms which were viviparous were reared in our laboratory within glass vials. Parthenogenesis was studied upto the fourth generations in the laboratory during the months of February and March 1945. The life cycle ran thus—

alate form
↓
apterous form
↓
apterous form
↓
apterous form

Curiously, we did not obtain any alate form in our culture in glass vials, but the alate and apterous forms both appeared when apterous specimens were reared on a pot plant of *C. gigantea*, R.Br., kept within our laboratory in the month of April, 1945. Of the apterous forms born of the alate within glass vials, the longevity during the months of February and March 1945 extended to twenty days. The largest number of young produced by a single apterous female was forty-seven and the maximum number of broods produced within 24 hours was seven. The young undergo four moults. The interval between each instar was irregular. The young reared in the last part of February, 1945 usually moulted in the following manner—

First moult—4th day after emergence.
Second moult—5th day after emergence.
Third moult—7th day after emergence.
Fourth moult—9th day after emergence.

Association of Ants.—We have not come across any record of ant association with this species of aphid in India. Moreover, Wheeler (1910) quotes Mordwilko stating that the siphons are best developed in aphids which do not live in droves and are not attended by ants. But we find that these aphids live in droves though their siphons are well developed. Moreover, we find that though association with ants is not common there are few instances where an association with two species of ants occurred. *Cremastogaster dorhni*, Mayr., and *Acantholepis frauenfeldi*, Mayr., were attending the aphid. The ants stroke and caress the aphids by touching the extremities of their body with their antennae: first with one and then with the other antenna. The latter is moved extremely rapidly. The aphid responds to the solicitude of the ant by raising its abdomen a little and releasing from its anal aperture a drop of transparent liquid which rolls down the ant's mouth.

Now it happens that the aphids survived on the host plant till late in April when attended by the ant *A. frauenfeldi*, Mayr., while they disappeared from all other plants even from the plant on which the ant *C. dorhni*, Mayr., was to be found abundantly, if no *A. frauenfeldi*, Mayr., was attending. It may be inferred that the latter species of ant gave better protection than the former species.

Minute yellow mites are also found in abundance near about the aphids.

Enemies.—Two species of lady-bird beetles *Chilomenes sexmaculata*, Fabr., and *Scymnus* spp., which were very abundant from the latter part of

January, were its chief enemies. They, in their larval and imago stage, especially in the former one, destroyed large number of aphids. The larvae of ladybirds catch hold of them on the sides and suck them dry.

Thysanopterous nymphs also attack the aphids and suck their juice.

Common Syrphids (*Diptera*) actively deposit their white eggs near the aphid colony and their blind larvae suck large number of aphids dry.

Aphids also disappeared overnight probably due to attack of some diseases as has been recorded by Das (1918).

MEASUREMENTS

(Of Specimens mounted in Berlese Medium)

Apterous viviparous female.—Body length, 2.407 to 2.8768 mm. (av. 2.6364 mm.); body width (abdomen), 1.363 to 1.8038 mm. (av. 1.5629 mm.); antennæ total, 1.7226 to 2.0901 mm. (av. 1.8387 mm.); I, 0.0986 to 0.1175 mm. (av. 0.1164 mm.); II, 0.079 to 0.1044 mm. (av. 0.0865 mm.); III, 0.406 to 0.551 mm. (av. 0.4587 mm.); IV, 0.2944 to 0.3951 mm. (av. 0.3322 mm.); V, 0.2277 to 0.2813 mm. (av. 0.2444 mm.); VI, 0.5394 to 0.6612 mm. (av. 0.5993 mm.); spur, 0.4205 to 0.5191 mm. (av. 0.4716 mm.); cornicles, 0.5104 to 0.6496 mm. (av. 0.5693 mm.); cauda, 0.232 to 0.2697 mm. (av. 0.2529 mm.); hind tarsus, 0.1494 to 0.1958 mm. (av. 0.1694 mm.).

Alate viviparous female.—Body length, 1.97 to 2.73 mm. (av. 2.4254 mm.); width of thorax, 0.819 to 0.936 mm. (av. 0.8965 mm.); antennæ total, 1.5434 to 1.9442 mm. (av. 1.7525 mm.); I, 0.0816 to 0.116 mm. (av. 0.0931 mm.); II, 0.058 to 0.0798 mm. (av. 0.0707 mm.); III, 0.0495 to 0.4963 mm. (av. 0.4514 mm.); IV, 0.2925 to 0.3851 mm. (av. 0.3287 mm.); V, 0.2165 to 0.2789 mm. (av. 0.2504 mm.); VI, 0.4729 to 0.6215 mm. (av. 0.555 mm.); spur, 0.3637 to 0.485 mm. (av. 0.4296 mm.); fore wing length, 3.2335 to 3.4887 mm. (av. 3.3088 mm.); fore wing width, 1.2079 to 1.2992 mm. (av. 1.2582 mm.); hind wing length, 1.769 to 1.9785 mm. (av. 1.8975 mm.); hind wing width, 0.551 to 0.609 mm. (av. 0.5934 mm.); cornicle, 0.3814 to 0.4785 mm. (av. 0.4109 mm.); cauda, 0.145 to 0.2204 mm. (av. 0.1757 mm.); hind tarsus, 0.1365 to 0.174 mm. (av. 0.1522 mm.).

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NOTES ON SOME BUTTERFLIES

FROM

PENANG AND PROVINCE WELLESLEY, MALAYA.

BY

LT.-COL. J. W. RAWLINS.

A list of butterflies collected by L. R. Wheeler in Penang was published in *The Entomologists Record* and *Journal of Variation*, vol. liv. 1942. This list contains 168 species collected over a period of three years. In view of this I hesitated to record the results of only three months collecting but have decided to do so as I can add 19 species to Wheeler's list all of which were taken on the Island. These 19 species include some rare and interesting butterflies which have been identified by Dr. A. S. Corbet of the British Museum (Natural History) to whom I am most grateful for the help he has given me.

I went to Malaya with the force that reoccupied the country in 1945 and by the end of September found myself stationed in Butterworth on the coast opposite Penang Island. Unfortunately I was only there for three months, the three wettest months of the year, when butterfly life is at its lowest. Collecting was possible only on Sundays and on the odd half day now and again or my list might well have been longer. Nevertheless I seem to have had my share of beginner's luck and added a number of species which were new to my collection.

Province Wellesley consists of a strip of territory on the west coast of Malaya, bounded on the north by the Muda and on the south by the Krian rivers. To the east the boundary is entirely artificial and runs approximately parallel to the coast and some ten miles from it. The country is for the most part flat and heavily cultivated. It consists largely of paddy fields, rubber, and cocoanut plantations. There are no hills worth speaking of except at Bukit Mertajam. Here there is a small group of hills thickly forested, with several streams and an artificial lake in the catchment area.

Penang Island lies some two miles off the coast. It too is heavily cultivated; rice, rubber, and cocoanut plantations cover the coastal areas. In the centre is a small group of hills rising to Penang Hill which is 2,700 ft. high. In the north these hills fall steeply to the coast and are still largely covered with natural forest. A part of Penang Hill was cleared some twenty or thirty years ago. This, I believe, has had some effect on the rainfall. A good deal of secondary growth has grown up recently. The Waterfall (Botanical) Gardens at the foot of Penang Hill lie in a re-entrant in the hills with a stream flowing through the middle of them. The gardens were used as an ammunition dump by the Japanese and at the time at which I was in Malaya they had suffered from neglect and were closed to the public owing to the danger from live ammunition. The flowering trees and shrubs attracted many butterflies and it was in and around the gardens that I did most of my collecting.

Penang is not rich in butterfly life, but a number of rare species are able to maintain themselves in the forested area on the northern part of the Island. I concentrated my attention on Penang rather than the mainland, partly because it was more accessible to me and partly because Penang has a fascination of its own. Its forests are full of birds and from the tops of the hills one can look out across the tree tops over the sea to the mainland and Kedah Peak wrapped in cloud.

The butterflies north of the Krian river are in some cases intermediate between, or even belong to the Burmese rather than the Malayan race. For example, *Amblypodia atosia* from Penang appears to conform to the Burmese rather than the true Malayan race. Hence in the list which follows, in doubtful cases I have adhered to the binomial rather than attempt the trinomial system of nomenclature. In preparing the list Corbet and Pendlebury's 'Butterflies of the Malay Peninsula' has been followed throughout except in one or two cases. Species taken on Penang Island which do not appear in Wheeler's list are marked with an *.

PAPILIONIDAE.

1. **Troides helena cerberus** (Feld). N.R. Found on the island and mainland.

2. **Papilio varuna** (White.) N.R. Often seen flying high around lower slopes of Penang Hill.

3. **P. aristolochiæ** (F.) N.R. Island and mainland.

*4. **P. paradoxa** (Zink). Two ♂ were taken on jungle paths below Penang Hill. One or two others seen. ♀ is excessively rare. Fond of resting on wet mud.

5. **P. memnon agenor** (L.) Not very plentiful at this time of year.

6. **P. helenus** (L.) Common around Penang Hill.

7. **P. iswara** (White.) Two ♂ taken on 14 Dec. '45 at 1,000 ft. in Batu Feringgi Catchment Area. They were newly hatched and in company with two others which were flying round and alighting on a hybiscus bush which they were unwilling to leave even after I had taken the first specimen.

This butterfly has a very distinctive flight and is readily distinguished from *P. helenus*. Distant in his Rhopalocera Malayana quotes Mr. Wallace on this species as follows :—

'*P. iswara* has an undulating flight, like that of the South American Morphos, or even sometimes approaching that of the *Noctuidae* and they rest with the upper wings deflexed over the lower.'

Distant states that it does not appear to be an abundant species. Corbet and Pendlebury describe it as 'somewhat local'.

8. **P. polytes romulus** (Cr.) Common everywhere.

9. **P. demoleus malayanus** (Wall.) Not so common as its Indian counterpart.

10. **P. antiphates itamputi** (Btlr.) One ♂ taken on latana at Bukit Mertajam on mainland.

11. **P. sarpedon** (L.) N.R. Occurs on Island as well as mainland.

12. **P. agamemnon** (L.) Not very common at this time of year.

PIERIDAE.

*13. **Leptosia nina malayana** (Fruh.) Abundant everywhere along jungle paths.

14. **Delias hyparate matarete** (Btlr.) N.R. on Penang.

15. **Appias lyncida vasva** (Fruh.) Not very common at this time of year.

16. **Catopsila pyranthe** (L.) Common.
17. **C. crocale** (Cr.) Common.
18. **C. scylla** (L.) Fairly common on the Island and mainland.
19. **Eurema hecabe** (L.) Common everywhere.

DANAIDAE.

*20. **Danais aspasia** (F.) Occurs on the Island and mainland but is rare.

21. **D. similis vulgaris** (Btlr.) Very common everywhere.

22. **D. melanippus** (Cr.) Fairly common.

23. **D. chrysippus margharita** (Röb.) Fairly common.

24. **Ideopsis gaura parakana** (Fruh.) Not uncommon around the top of Penang Hill, but difficult to capture as it flies fairly high. I did not see it on the mainland.

25. **Euploea mulciber** (Cr.) Common on Penang.

26. **E. diocletiana** (F.) One ♂ taken on top of Penang Hill. No others seen.

SATYRIDAE.

27. **Mycalecis fuscum** f. (Feld.) Somewhat local. I never failed to find it at Bukit Mertajam but never came across it on the island.

28. **M. mineus** (L.) Very common.

29. **Ypthima huebneri** h. (Kirby). Very common.

30. **Y. baldus** (F.) Common.

31. **Orsotrioena medus** m. (F.) Common.

32. **Elymnias hypermnestra** (L.) The ♂ is common everywhere. In North Burma and in Rangoon I always found the ♂ of this butterfly more plentiful than the ♀. On the other hand at Kallar, South India, the ♀ of *E. hypermnestra caudata* seemed more plentiful than the ♂. Specimens of *E. hypermnestra* from Penang appear to be intermediate between the true Malayan race and Burmese race. A sufficient series was not obtained to say whether or not the Penang race is E. hypermnestra beatrice the true Malayan race.

AMATHUSIDAE.

33. **Faunis arcesilaus** (F.) Occurs on the Island and mainland. Not a very common species and difficult to capture. It is fond of resting on forest paths among dead leaves and when disturbed it flies slowly up the path very close to the ground for a few yards and then turns off into the thickest jungle where it is impossible to follow.

The only representative of this family that I came across though others do occur.

NYMPHALIDAE.

34. **Eribœa athamas** (Drury). Fairly common at Bukit Mertajam.

35. **Euthalia cocytina puseda** (Mre.) R. I found this butterfly in one place only just above the Waterfall Gardens, where several were seen. Generally settled fairly high on the leaves of trees out of reach.

*36. **E. garnda** (Mre.) R. Penang Island.

*37. **E. lubentina** (Cr.) R. One ♂ of this lovely butterfly taken on animal droppings in a small nallah on Penang Island. Within two or three inches of it was a specimen of *Pantoporia asura idita* which returned to the same spot within a few minutes and was also taken.

38. **Adolias dirtea** (F.) Fairly plentiful especially on Penang. As usual with this butterfly the ♀ was more plentiful than the ♂.

39. **Parthenos sylvia lilacinus** (Btlr.) I did not take this butterfly on Penang though it occurs at Bukit Mertajam. It is a slightly smaller insect than the South Indian race and as its name implies has a rich violet tinge.

40. **Limenitis procris milonia** (Fruh.) Not common at this time of year. Found on the Island and mainland.

*41. **Pantoporia asura idita** (Mre.) I took this butterfly both on the Island and mainland. It is attracted by animal droppings. Fond of flying near the ground over damp open patches in jungle.

42. **Neptis vikasi omeroda** (Mre.) Presumed to occur on Penang. Two specimens seen at very close quarters which I failed to secure.

43. **N. hylas** (L.) Common.

44. **Precis orithya wallaci** (Dist.)

45. **P. alamana javana** (Feld.) All are common. *P. atlites* being

46. **P. atlites** (L.) the commonest.

47. **P. iphita horsfield** (Mre.)

48. **Cupha erymanthis lotis** (Sulz.) Common on Island and mainland.

49. **Cethosia methypsea** (Btlr.) Fairly common on the higher slopes of Penang Hill. ♂ ♂ only were seen.

Erycinidae.

*50. **Abisara neophron cheline** (Fruh.) Not common on Penang or mainland.

51. **A. kausambioides** (Nic.) Rare on Penang though commoner at Bukit Mertajam.

Lycaenidae.

*52. **Gerydus boisduvali** (Mre.) V.R. Penang Island. One ♂ was taken on 10 Nov. 45 near the Waterfall Gardens. Understand from Dr. Corbet this insect is V.R. throughout Malaya.

53. **Allotinus horsfieldi** (Mre.) Common everywhere.

54. **Castalius rosimon** (F.) Common everywhere.

55. **C. ethion** (Dbl. & H.) Probably occurs on Penang. One specimen was observed which I assumed to be this butterfly, but it kept just out of reach.

*56. **Pithecops hylax corvus** (Fruh.) R. Penang Island.

57. **Celestrina pellecebra** p. (Fruh.) R. Penang.

58. **Zizeeria otis** (F.) V.C. everywhere.

59. **Euchrysops cnejus** (F.) N.R.

*60. **Lycænesthes emolus goberus** (Fruh.) R. Penang.

61. **Lampides boeticus** (L.) V.C.

62. **Amblypodia atosia** (Hew.) Both common on Penang.

63. **A. raflesii** (Nic.) A. atosia from Penang is blue and resembles the Burmese race rather than the true Malayan race which is purple on the upperside.

64. **A. eumolphus maxwelli** (Dist.) R. One ♂ and three ♀ were taken on 21 Sept. 45 at Bukit Mertajam within a few yards of each other.

65. **A. abseus** a. (Hew.) R. Penang.

*66. **Loxura atymnus fuconius** (Cr.) N.R. on Penang or mainland.

*67. **Spindasis syama terana** (Fruh.) R. Penang.

*68. **Biduanda thesmia** (Hew.) R. Penang.

69. **Marmessus lisias** (F.) R. Penang.

*70. **Catapœcilma major emas** (Fruh.) R. Penang. One ♂ taken in Waterfall Gardens on 16 Dec. 45. Wheeler took C. elegans in much the same place. The two butterflies are difficult to differentiate.

*71. **Rapala suffusa** S. (Mre.) V.R. One ♂ taken in Waterfall Gardens.

72. **R. jarbas** (F.) R. Three ♂ and a ♀ were taken near Waterfall Gardens. A fast flying insect, has the habit of flying up and down a path and alighting momentarily on a bush or plant. Even when disturbed it will return to the same spot.

*73. **Sinthusa nasaka amba** (Kirby). V.R. Penang.

Hesperidae.

74 **Orthopætus phaneus** (Hew.) R. Penang. One ♂ taken late in evening as rain was beginning to fall.

*75. **Charmion ficulnea** (Hew.) N.R. Penang.

76. **Celænorrhinus asmara** a. (Btlr.) R. Penang.

77. **Tagiades gana perakana** (Fruh.) N.R. Penang.

78. **Iambrix salsola** (Mre.) Common both on the Island and mainland.

*79. **Koruthaialos xanites** (Btlr.) N.R. Penang. I did not see this on mainland.

80. **Sancus pulligo** (Mab.) N.R. on mainland.

81. **Kerana nigrita** (Latr.) N.R. Penang. Quite common at Bukit Mertajam.

82. **Notocrypta paralysos** (W.M. and Nic.) N.R. Penang.

83. **Erionota thrax** (L). Large insects that fly at dawn and dusk and are attracted by light.

*84. **E. taurus** (Evans). I have a ♀ of both *E. thrax* and *E. taurus* both taken indoors at dusk at Butterworth where they are by no means uncommon. One or other, probably both, are certainly present on Penang Island. *E. taurus* was separated from *thrax* by Brigadier Evans in 1941. The genitalia of the ♂ ♂ differ considerably though the ♀ ♀ are practically indistinguishable.

E. thrax. ♀ F. W. apex acute, termen straight, F. W. vein 1 is equal to vein 7 of H. W.

E. taurus. ♀ F. W. apex rounded, termen slightly convex. F. W. vein 1 shorter than vein 7 of H. W.

85. **Hidari irava** (Mre.) R. both on Penang and mainland. Rather variable in colour. Like *Erionota* this insect is attracted by light though it seems to fly by day more frequently than *Erionota*.

86. **Padraona mæsoides** (Btlr.) C. everywhere.

87. **Baoris conjuncta javana** (Mab.) Fairly common on mainland though I failed to find it on Penang Island.

NOTES ON BIRDS COLLECTED AND SEEN IN PERSIA,

1935 to 1945.

BY

A. C. TROTT.

The following notes relate to birds collected by, or seen by me during the period 1935 to 1945 in Persia. My usual place of residence has been Tehran, the capital, but I have also travelled to other parts of the country. I have also incorporated a few reports from friends when I felt sure that they knew the bird concerned: and some notes left to me by Mr. Brotherston, who spent some months as an officer in the south of Persia, at Ardekan, and at Kazvin, have also been inserted. For the identification of specimens I am indebted to the Natural History Museum. I have tried to include all the birds I saw or collected: one or two of the very common birds, e.g. the mallard, have not been included as I never secured specimens and did not actually note the bird on any particular date. The expression 'Lar valley' in which I obtained a number of birds is nothing to do with the town of Lar in the province of Fars in South Persia: it refers to the valley in the Elburz range which leads towards Demavend, and lies 30 miles north east of Tehran.

Corvus corax Linnaeus. Raven.

Ravens are often seen near Tehran: I have a note of a pair seen east of Tehran on the 28th Feb. Many fine ravens were seen in the Siah Palás valley (which leads into the Lar, on the Caspian side of the Elburz watershed) at an altitude of 8,000 ft., at the end of July.

Corvus cornix cornix Linnaeus. Hooded Crow.

The hooded crow is one of the commonest birds of Tehran: the Tehranis say that the white of the egg is good as an eye-salve. They are fond of nesting in high plane-trees, which abound at Tehran.

Corvus cornix ? sharpii Oates. Sharpe's Crow.

Seen between Resht and Masuleh in Gilan, March.

Corvus frugilegus frugilegus Linnaeus. Rook.

Innumerable rooks are to be seen at Tehran throughout the winter.

Pica pica bactriana Bonaparte. Magpie.

These resident and ubiquitous birds certainly go up as far as 9,000 ft. as I saw one at the top of the Tirak pass above Mubarakabad on the 28th July. It sometimes flies about in the summer (e.g. at Avcheh village in August) making its curious call, which sounds like '*ker-plonk*'.

Pyrrhocorax pyrrhocorax pyrrhocorax (Linnaeus). Red-billed Chough.

I saw some of these birds at Shiraz in the winter: the local people said they were good to eat. I sent home a skin from north of Tehran (Elburz foothills) in January. On the 28th July I saw a colony of these choughs at 7,000 ft. on the Tirak pass leading from Mubarakabad to Siah-Palás and the Lar valley. The young birds which had evidently recently been hatched were making a curious squeaking noise.

Sturnus vulgaris caucasicus Lorenz. Starling.

1 ♀ Tehran. Feb. 2.
1 ♂ near Gulhek. juv. March 15.

I noted huge flocks of starlings near Robat Kerim on the 14th November. They breed at Gulhek: I saw some there on the 10th June and young ones on the 12th July: they were nesting in walnut trees. I also saw some at a village near Hamadan on March 30th, and near the Assadabad pass on August 9th.

Pastor roseus (Linnaeus). Rose-coloured Starling.

1 ♀ Surkh Hissar, 10 miles east of Tehran. May 14.
1 ♂ Village Bábá-Salmán, 20 miles S.W. of Tehran. June 25.

These birds evidently arrived in the Tehran area in some numbers between the 7th and the 14th May: the one I shot on the latter date was with several others in a tree. The second one was one of a flock of four, but many more were seen near by. The local people call this bird *sári-i-ablaq*, as distinct from the simple *sár* which means the common starling. The rosy pastor is the bird which the Persians say can be so useful in getting rid of locusts: according to the well-known fable anyone who has a plague of locusts has to travel to a certain well at Qazvin and get from it a bottle of water: he must then take the bottle to the place where the locusts are and break it on the ground, when rosy pastors will appear by magic and eat up the locusts. I saw no young, and did not see any after June 14.

Oriolus oriolus oriolus (Linnaeus). Golden Oriole.

I shot a pair of orioles at Tehran on the 20th May. They are very common birds at Gulhek in the summer from June to September. On the 30th June a pair were seen nesting at Tajrish, 10 m. north of Tehran.

Coccothraustes coccothraustes coccothraustes (Linnaeus) Hawfinch.

1 ♀ Tehran Legation. Jan. 16.
1 ♂ Gulhek, north of Tehran. Feb. 2.

The earliest date on which I saw hawfinches was Jan. 4th, and the latest Feb. 23rd, at Gulhek. Their visits to Tehran seem to be irregular, for in some years I never saw any, though I was on the watch for them.

Chloris chloris (Linnaeus). Greenfinch.

1 ? Gulhek. Feb.

Shot on a branch of a plane tree: consorting with siskins.

Carduelis carduelis loudoni Zarudny. Goldfinch.

1 ♂ near Gulhek. Feb. 16.

Goldfinch are very common at Tehran in February and March: my earnest record of them is a flock on a tree in the Legation garden on Jan. 15th: and my last a big flock on the golf-course, Tehran, on the 30th March. Mr. Brotherston saw some at Kazvin on June 20th.

Carduelis cannabina bella (= *fringillirostris* Bp. & Scl.) Linnet.

1 ♀ Lar valley, near Deli Chai camp. July 14.
1 ♀ same place. July 14.
1 ♂ same place July 15. One of a pair.

These linnets were flitting about on low bushes and appeared to have just arrived. They were consorting with grosbeaks (*Carpodacus*). I saw a pair on a hillside near Safid-áb, at an altitude of about 9,000 ft., on the 6th August.

Spinus spinus (Linnaeus). Siskin.

1 ♀ Gulhek. Feb. 16

Flocks of siskins were sometimes to be seen on the foothills north of Tehran in February and March.

Metaponia pusilla (Pallas). Gold-fronted Finch.

1 ♂ near Chihil Cheshmeh spring, 7,000 ft. Aug. 4. Testes v. large.
1 ♂ same place. July 13. Testes v. large.

I saw this fine little bird continually, flying near the spring: it was very bold and tame: no females were found, nor a nest, but I feel sure it must be breeding in the rocks near Chihil Cheshmeh in the Lar Valley.

Rhodopechys sanguinea sanguinea (Gould). Crimson-winged Finch.

1 ♂ near Chihil Cheshmeh spring in Lar valley. July 13.
1 ♀ same place: drinking in the spring. Aug. 4.

I saw the bird once more at the spring on the 5th August: and also one which settled near the river, evidently making for the spring. It was not so common as the Gold-fronted Finch but the red patches on breast and wing made it very conspicuous and remarkable.

Carpodacus erythrinus roseatus (Hodgson). Scarlet Rose-finch or Grosbeak.

1 ♀ Deli Chai camp in Lar Valley. July 10.
1 ♂ same place. Organs not large. Very common. July 14.
1 ♂ Chihil Cheshmeh, near the spring: very conspicuous on umbellifers. Making characteristic call or churr. Aug. 3. Testes large.
1 ♀ same place. Very common. Aug. 3.

These birds were calling to one another, especially in the evening and were, I feel sure, breeding. The call was a sort of plaintive combination of *churr* and *peep* with the note rising at the end: this monotonous single call went on for a long time.

Fringilla coelebs subsp.? Chaffinch.

1 ♀ Gulhek. Feb. 12.

The chaffinch is common round Tehran from November to February: flocks of 20 or 30 are often seen in the Legation feeding on grass during that period. Mr. Brotherston saw some at Ardekan on Dec. 18. On the 4th January I watched chaffinches feeding on the seeds of catalpa trees in the Legation: they were picking the seeds out of the old pods which remained on the trees. I saw flocks of them between Resht and Masuleh, in Gilan, on March 11.

Fringilla montifringilla Linnaeus. Brambling.

1 ? Near Gulhek. March.

I saw a brambling in the Legation garden on the 16th Jan.: another a few miles north in February, and the last one about the middle of March. I also saw one in Gilan, in the jungle between Resht and Masuleh, on the 11th March.

Montifringilla nivalis alpicola (Pallas). Snow Finch.

1 ♀ Chihil Cheshmeh spring. July 13.
1 ♂ same place. Aug. 3. Testes small.

Flocks of about 40 snow finches were continually doing evolutions in perfect timing, all wheeling at the same instant and then all perching on the rocks, round the spring in the Lar valley. Some birds had a white spot under the chin. I believe that they were breeding in that valley though I found no nests.

Petronia petronia exiguus (Hellmayr). Rock Sparrow.

1 ♂ Chihil Cheshmeh spring. Lar valley. July 13.
This was the only time I noted this bird: it was drinking at the spring.

Passer domesticus ? biblicus Hartert. House Sparrow.

2 ♂ ♀ Gulhek. 5,000 ft. March 15.
House sparrows were not common at Tehran or in the neighbourhood. I noticed a good many at Bushire in December, and at Ahwaz on the 17th February: also at Sádeghabad near Hamadan on the 30th March. Mr. Brotherston saw some at Kazvin on the 19th June.

Passer hispaniolensis transcaspicus Tschusi. Spanish Sparrow.

1 ? Abadan, sea level. December.
This bird had been caught accidentally in a trap.

Passer montanus subsp.? Tree Sparrow.

Seen by Mr. Brotherston at Kazvin on July 25.

Emberiza citrinella erythrogenys C. L. Brehm. Yellow Bunting.

1 ♀ Near Gulhek. Feb. 17.
2 ♂ ♀ Near Tehran. Jan.
1 ? Lar valley: near Deli Chai. Fat. Sex undetermined. July 13.
1 ♀ Lar valley: safid-áb: in grass. 7,000 ft. Aug. 1.
The yellow bunting is very common in spring at and near Tehran, usually in flocks among the growing wheat and barley. I also saw a good many in the Lar valley at the end of July.

Emberiza hortulana Linnaeus. Ortolan Bunting.

1 ? Near Tehran. March.
The ortolan bunting is seen near Tehran occasionally in spring: I saw one at Surkh Hissar, 10 miles east of Tehran, early in March.

Emberiza melanocephala Scopoli. Black-headed Bunting.

1 ♂ Surkh Hissar, 10 miles east of Tehran. April 30.
The black-headed buntings come rather later than the yellow buntings and are often in large flocks, feeding in the wheat and barley. Mr. Brotherston saw some at Kazvin on the 20th June.

Ammomanes deserti fraterculus Tristram. Desert Lark.

1 ? Isfahan, 5,500 ft.: near Siah-kuh. Sept. 18.

Galerida cristata subsp.? Crested Lark.

1 ♂ Near Gulhek. Feb. 17.
Crested larks were always common on the plains round Tehran. On coming back from the high passes of the Lar valley I noticed the first crested lark at Lárak, about 6,000 ft.: the bird does not seem to go higher than that. I saw some at Bushire in December.

Alaemon alaudipes subsp. Bifasciated Lark.

I saw this bird at Huleila, on Bushire island, on Dec. 16. It was on the sea-shore.

Otocorys alpestris albigula Bonaparte. Shore Lark.

1 ♀ Sultanatabad near Tehran: Feb. 5.

I saw a flock of about 30 of these birds near Jajarud in the high ground, on snow, at about 6,000 ft., on March 1st. During the winter a heavy fall of snow usually drives some of them to seek their food quite close to Tehran: I saw some just north of the town in February.

Otocorys alpestris penicillata (Gould). Shore Lark.

1 ♀ Lar valley: near Deli Chai: solitary: shot in evening: July 10.
1 ? ♀ juv. near Sefid-áb in Lar valley: one of a party of four: July 13.
1 ♂ near Deli Chai camp. Organs small; solitary. July 31.

All these three specimens were from the Lar valley: the bird did not appear to be common but it looked as if it was breeding there, or very near there in one of the high valleys on the Caspian side of the watershed. Buxton points out that the race *penicillata* occurs as far south as Isfahan: evidently therefore this race and *albigula* overlap.

Anthus pratensis (Linnaeus). Meadow Pipit.

1 ♀ Lar valley: near Deli Chai. July 10.

This bird was shot in bushes. Organs undeveloped. I have notes of the bird at Bushire on December 15th.

Anthus sordidus ? decaptus Meinertzhagen. Brown Rock Pipit, or Plain Pipit.

1 ♀ near Deli Chai camp in Lar valley found on nest. July 12.

This bird had a well-concealed nest in a clump of *achillea* in a level part of the valley: the nest had three eggs, which I secured. I did not see the mate. The female ran some way when sent off the nest, and in appearance reminded me of a bifasciated lark, only smaller. It is therefore certain that this bird breeds in the Lar valley in July. I have not found any reference to this bird as far north as the Elburz mountains: Blanford mentioned one obtained in April 50 miles north of Isfahan, at 5,000 ft. We now know that it breeds at 7,000 ft. considerably further north.

Anthus trivialis trivialis (Linnaeus). Tree Pipit.

Mr. Brotherston saw one at Ardekan on the 21st January.

Motacilla flava subsp. Blue-headed Wagtail.

1 ♂ Lar valley: Deli Chai. juv. July 9. organs very small.

Motacilla flava feldegg Michahelles. Black-headed Wagtail.

I saw two of these birds in the Lar valley between Chihil Cheshmeh and Safid-áb on July 13th, and shot them but unfortunately did not manage to save their skins. They were in very good feather, the yellow breast being of a beautiful canary shade, contrasting with the jet-black head. I watched a few more flitting about on bushes.

Motacilla alba persica Blanford. White Wagtail.

1 ♂ Gulhek. March 15.

The white wagtail is common round Tehran especially in the spring. I saw some at Bushire on the 15th December, and Mr. Brotherston saw some between Ahwaz and Tehran on the 12th June.

Sitta neumayer rupicola Blanford. Lesser Rock Nuthatch.

1 ? Lar valley: Chihil Cheshmeh: near spring: July 13.

Another one looking just the same was seen on August 1st near the Div-asiáb in the Lar valley, at about 10,000 ft.: and another at Puloor (about 5,500 ft.) on July 16.

Sitta europea persica Witherby. Nuthatch.

1 ? Pir-i-Zan pass, 60 miles w. of Shiraz: creeping about branches of bushes.

I also have notes of nuthatches near Tehran on two occasions: (1) February 28th at the village of To-chal east of Tehran on the old Khorasan road, and (2) March 1st, a company of 12 on the high ground at Jaja-rud: but these were probably *S. tephronota.* I also saw one on a tree at Noglabar, on the road to Resht on the borders of Gilan, on March 13th.

Parus major blanfordi Prazak. Great Tit.

1 ? Tehran. January.

1 ? near Tehran. February 28.

The great tit is very common in the trees of Tehran from January to March. One sees it throughout the year also: I have records of it at Gulhek in July. They are in very good feather in the middle of March. Mr. Brotherston noted one at Kazvin on the 19th June.

Remiz pendulinus (Linnaeus). Penduline Tit.

I never saw this bird, but its nests were hanging from the tips of poplar branches in what is called the 'bisheh' on the Julfa side of the river at Isfahan.

Regulus ignicapillus ignicapillus (Temminck). Firecrest.

I saw a firecrest early in March at Surkh Hissar, 10 miles east of Tehran: it was flitting about the tops of elm trees and was just distinguishable among the swelling elm buds. I shot one on the 5th March but the impact of the shot blew it to pieces.

Lanius collurio Linnaeus. Red-backed Shrike.

1 ♂ Surkh Hissar, 10 m. east of Tehran. April 30.

1 ♂ Lar valley. Near Safid-áb confluence with Lar river: Testes fairly large. August 1.

This bird was not common near Tehran.

Pycnonotus leucotis mesopotamiae Ticehurst. White-eared Bulbul.

I saw and heard this bird at Bushire on the 15th December: and also saw an albino in a cage there. I also saw the bird at Ahwaz on the 17th February.

Muscicapa striata neumanni Poche. Spotted Flycatcher.

1 ♀ Surkh Hissar, 10 m. E. of Tehran. May 7.

Spotted flycatchers were in the gardens round Tehran from about April 30th to May 10th.

Ficedula hypoleuca semitorquata (Homeyer). Pied Flycatcher.

1 ♂ Chal-Harz, 10 miles north of Tehran. March 15.

I also saw one at Gulhek on the 13th March, and Mr. Brotherston saw one at Kazvin on the 20th June.

Agrobates galactotes (Temminck). Rufous Warbler.

Mr. Brotherston saw one at Kazvin on the 21st June.

Turdus ericetorum philomelos Brehm. Song-Thrush.

1 ♂ Tehran Legation. January 18.

Song-thrushes are fairly common at Tehran from January to March: I saw a young one at Gulhek on the 24th March. Mr. Brotherston saw one at Ardekan on the 9th January.

Turdus merula aterrimus (Madarasz). Blackbird.

1 ♂ Tehran Legation. January 18.

Blackbirds are common, and vociferous, in the gardens round Tehran from the middle of January to the end of March: on the 28th March they were singing well. I saw one on the lawn at Gulhek on the 10th June. I also noted them at Ahwaz on the 17th February.

Turdus ruficollis atrigularis Temminck. Black-throated Thrush.

1 ♂ Gulhek. March 2.
1 ♀ Surkh Hissar, 10 m. E. of Tehran. March 14.

I have notes of this very common bird round Tehran from the 11th January to the 14th March. The amount of black below the chin varies considerably.

Monticola saxatilis (Linnaeus). Rock Thrush.

1 ♂ Deli-Chai camp in Lar valley. Full plumage. July 12.
1 ♂ Chihil Cheshmeh, Lar valley. juv. August 2.
1 ♂ Near the same: Juv. August 6.

This was one of the first birds I noticed when I entered the main valley on July 27th: the birds I saw then were mostly youngsters just beginning to fly. From then until Aug. 9th, when I left the valley, I frequently heard the sweet notes of their call, resembling that of the song-thrush. The third specimen was taken by hand, unable to fly. The bird evidently breeds in the valley, in July and early August.

Oenanthe deserti subsp? Desert Wheatear.

I saw one on the golf-course at Bushire on the 14th December.

Oenanthe finschi barnesi (Oates). Arabian Wheatear.

1 ? Jajarud: Kamard valley. January 5.

I also saw this bird between Tabas and Robat-i-Khan on the road to Yezd on the 9th October The local inhabitants at Jajarud told me that the bird was well known and called by them *mishka*.

Oenanthe leucomela leucomela (Pallas). Eastern Pied Wheatear.

1 ? Isfahan: desert south of town. juv. September 18.

Oenanthe oenanthe oenanthe (Linnaeus). Common Wheatear.

1 ♂ Lar valley. near Chihil Cheshmeh, in the valley leading south to Siah-palás. July 29. Testes small.

I saw the common wheatear again in the Lar valley on the 2nd August. Mr. Brotherston saw it at Kazvin on the 18th June.

Oenanthe chrysopygia (De Filippi). Red-rumped Wheatear.

I saw this bird on the bare hillside leading up to the Tirak pass between Mubarakabad and Lar, at about 7,500 ft., on July 27. And again on the pass above Avcheh leading over the watershed into the Lar valley, at 8,000 ft., on August 12.

Saxicola rubetra noskae (Tschusi). Whinchat.

2 ♂ ♀ near Deli Chai: juv. (Lar valley) July 10.
1 ♂ Lar valley: near Safid-ab confluence. juv. July 13.
1 ♂ Lar valley: Safid-ab camp. August. 1.
1 ♂ Lar valley: near Chihil Cheshmeh. August 2.

The whinchat was very common in the valley and judging from the number of young birds it seems very probable that it breeds there about June or early July.

Phoenicurus erythronotus (Eversmann). Eversmann's Redstart.

1 ♂ Sultanatabad, near Tehran. February 5.
1 ? Tehran. January.

Eversmann's redstart is common in January and February in the cultivation north of Tehran. It also appeared to be breeding at Surkh Hissar, 10 miles E. of Tehran, in March, in small bushes of *Berberis*. Redstarts were breeding in clefts of rocks throughout the Lar valley, at 7,500 ft., at the end of July. I watched the birds feeding their young on several occasions. The nest was usually so far in between two huge rocks that it was impossible to get at it.

At the beginning of August redstarts were very common round the rocks near Chihil Cheshmeh in the Lar valley: their black heads and red tails, with a constant quivering motion, were very noticeable. The last date on which I saw them there was Aug. 6.

Phoenicurus ochrurus (Gmel). Black Redstart.

One was seen by Mr. Brotherston near Ardekan on December 18.

Luscinia megarhyncha africana (Fischer & Reichenow). Nightingale.

Nightingales are to be seen and heard frequently in the gardens round Tehran from the 20th January to the middle of June, when their well-known and sometimes overpowering song ceases to be heard. It is a common cage-bird and if brought up in captivity is said to sing well. On the 9th October I noticed one in the desert between Tabas and Robat-i-Khan on the road from Tabas to Yezd.

Luscinia svecica subsp.? Blue-throat.

Blue-throats were only seen by me in the Lar valley: they seem to reach it after July 16th as I saw none on that date though I was looking for them: I saw an adult in good plumage near Chihil Cheshmeh on July 30th and obtained the following specimens:

1 ♂ Chihil Cheshmeh spring: August 4.
1 ♀ same place. August 4. juv. in speckled plumage.

I saw two or three other young birds in speckled plumage: all were drinking at the spring.

Erythacus rubecula hyrcanus Blanford. Redbreast.

1 ♂ Chal-Harz, just north of Tehran. March 20.

The redbreast is not a common bird near Tehran. In December I received one shot at Abadan.

Troglodytes troglodytes hyrcanus Zarudny & Loudon. Wren.

1 ? Tehran Legation garden. January 16.

The wren was only seen by me at Tehran during the third and fourth weeks of January. The specimen shot was remarkably dark in colour.

Cinclus cinclus caucasicus Madarasz. Dipper.

1 ? Gulhek, 7 miles north of Tehran. February.

This bird is also to be seen in July and August in the Lar river, at about 7,000 ft.: and also in the Kand river near the village of Kand in March. (20 miles N. W. of Tehran).

Hirundo rustica subsp.? Swallow.

Noted at Ahwaz on the 19th February, and on the Caspian Sea, near Babul Sar, on the 5th June.

Riparia rupestris (Scopoli). Crag-Martin.

I saw some crag-martins near the Chihil Cheshmeh spring in the Lar valley on July 29th, flying about hawking after insects at mid-day. Mr. Brotherston saw some between Ahwaz and Tehran on the 12th June.

Micropus apus subsp.? Swift.

Mr. Brotherston saw some swifts between Ahwaz and Tehran on the 12th June, and I saw some at the village of Baba-Salman, 20 miles S.W. of Tehran, on the 25th June.

Micropus melba melba (Linnaeus). Alpine Swift.

An officer who knew the bird well saw some Alpine swifts at Shimshak, 20 m. N.E. of Tehran, at about 6,500 ft., on the 31st May. Mr. Brotherston saw some at Ahwaz on the 5th June.

Caprimulgus europaeus subsp.? Nightjar.

Mr. Brotherston saw one at Kazvin on August 5.

Merops apiaster Linnaues. Bee-eater.

The common bee-eater is frequently seen round Tehran and indeed on most parts of the Persian plateau: my records from Tehran range between May 12th and September 4th. At Avcheh village at 6,500 ft. I watched a flock circling round and chasing insects on the 13th August. I saw some near Khorramábád in Luristan on the 16th April.

Merops orientalis biludschicus Neumann. Little Green Bee-eater.

I saw the little green bee-eater at Bushire on the 14th December, in large flocks.

Upupa epops epops Linnaeus. Hoopoe.

The earliest date I have for the hoopoe at Tehran is the 20th March: in June they were nesting at Gulhek: and on the 4th August I saw five in the Lar valley, at 7,000 ft.

Coracias garrulus garrulus Linnaeus. Roller.

This bird, which breeds in the Legation gardens at Gulhek, seems to reach the plateau round Tehran early in April, and remains till the end of August at any rate. In the Lar valley over the Caspian watershed I saw none: the last place at which I saw rollers in going from Tehran to Lar was at Avcheh village, about 7,000 ft.

Coracias benghalensis benghalensis (Linnaeus). Indian Roller.

Very common at Bushire on the 12th December.

Ceryle rudis rudis (Linnaeus). Pied Kingfisher.

Mr. Brotherston saw one between Ahwaz and Tehran on the 11th June.

Dryobates syriacus syriacus (Hempr. & Ehrenberg). Syrian Pied Woodpecker.

This woodpecker is one of the commonest birds in gardens at Tehran. It nests in the British Embassy compound at Gulhek between about the 26th June and the 12th July, often in walnut trees. Mr. Brotherston saw one at Kazvin on the 13th July, and I shot two, one a youngster, on the Tang-áb pass, 60 miles south of Shiraz on the road to Firuzabad, on the 2nd May.

Cuculus canorus canorus Linnaeus. Cuckoo.

1 ♂ Deli Chai camp, in Lar valley: July 12.

This bird was hawking about for flies near the camp early in the morning and looked very like a sparrow hawk at first. Its organs were fairly well developed. The well-known call is sometimes heard at Tehran in May and June. Mr. Brotherston saw one at Kazvin on the 13th July.

Bubo bubo ruthenus Buturlin & Zhitkow. Eagle Owl.

1 ♂ Gulhek. February 1.

These large birds are most often seen in the spring at Tehran, solemnly sitting in a tall tree, often being mobbed by small birds: but the owl usually takes no notice at all. The monotonous call disturbs the slumbers of many dwellers in Tehran. On the 29th November a young one was found in the British Legation garden unable to fly: it seemed to have been damaged but I could find no sign of a broken limb. Mr. Brotherston saw one near Ardekan on the 16th December.

Carine noctua bactriana (Hutton). Little Owl.

1 ♂ Gulhek. February 2.

Occasionally seen at Tehran in the spring. On the 12th June Mr. Brotherston saw one between Ahwaz and Tehran.

Falco peregrinus subsp.? Peregrine Falcon.

One was seen by Mr. Brotherston on the 17th June at Tehran.

Falco subbuteo subbuteo Linnaeus. Hobby.

1 ♀ Qaitarieh, a garden near Gulhek. September 29.

No doubt this bird breeds in the gardens round Tehran: the one I shot was with several others in an elm tree: the local name is *Qirqi* but that name may apply to other falcons too. I saw some newly fledged hobbies at Isfahan in August, where they breed in poplar trees: and Mr. Brotherston saw some near Kazvin on the 28th July.

Falco columbarius subsp.? Merlin.

Mr. Brotherston saw a merlin at Kazvin on August 5th.

Falco tinnunculus tinnunculus Linnaeus. Kestrel.

The common kestrel nests in many gardens near Tehran in June and July.

1 ? Surkh Hissar, 10 m. east of Tehran. May 7.

They often nest on the tops of large plane trees, and the screaming of the young birds is constantly heard. Another favourite breeding place is the gardens round Eurkh Hissar. I also saw kestrels at Hulaila on Bushire island on the 16th December, and in the valleys near the Lar valley between July 28th and August 6th.

Falco naumanni naumanni Fleischer. Lesser Kestrel.

1 ♂ Gulhek. March 15.

I also saw this bird on the shore of the Caspian near Rámsar in April.

Falco vespertinus vespertinus Linnaeus. Red-footed Falcon.

Mr. Brotherston saw one at Kazvin on the 18th June.

Buteo rufinus rufinus (Cretzschmar). Long-legged Buzzard.

1 ? Shah Abdul Azim, just south of Tehran. January.

This bird is sometimes seen north of Tehran during the summer.

Accipiter nisus nisus (Linnaeus). Sparrow-Hawk.

1 ♂ near Gulhek. February 19.

I did not find this bird common round Tehran. Mr. Brotherston saw one at Kazvin on the 30th July.

Milvus migrans migrans (Boddaert). Black Kite.

1 ? near Gulhek. January 2.

This bird is not uncommon around the foothills north of Tehran. I found a young one in the Legation at Gulhek on July 15. I also saw some on the Caspian foreshore near Babul-sar (Meshed-i-Sar) on May 30th. Mr. Brotherston saw some between Ahwaz and Tehran on the 12th June. Many were to be seen round the Chihil Cheshmeh camp in the Lar valley on August 2nd: at a height of 7,000 ft.

Pandion haliaëtus (Linnaeus). Osprey.

I saw an osprey fishing in the Lar river, at an altitude of 7,000 ft. on July 13th: and another fishing in the Caspian sea on the 4th June.

Gypaëtus barbatus subsp. Bearded Vulture.

Seen by Mr. Brotherston at Kazvin on August 5th. I sometimes saw them in the air near Tehran during the summer.

Neophron percnopterus (Linnaeus). Egyptian Vulture.

Often seen round Tehran, especially in the winter. Mr. Brotherston saw one at Ahwaz on the 6th June.

Gyps fulvus fulvus (Hablizl). Griffon Vulture.

These huge birds no doubt breed in the Elburz range, especially in the high mountains round Demavend: colonies of them can be seen in that neighbourhood occasionally. On the 16th July I saw about 30 sated birds round a corpse near the Deli Chai confluence with the Lar river, at 7,000 ft. Mr. Brotherston saw some near Tehran on the 17th June: I have also the three following records of my own: 9th December: south of Tehran: a few feeding on a corpse; 6th October: between Zahidan (Duzdab) and Shusp; and 12th October: near Qum, 90 miles south of Tehran.

Aegypius monachus (Linnaeus). Black or Cinereous Vulture.

I saw one of these birds with other vultures round a dead mule near Qum on October 12th. I also kept one for some time in the Legation compound alive, from the 13th October.

Ciconia ciconia (Linnaeus). White Stork.

Col. Day, R. E., informed me that a colony of storks were nesting at Sar-i-Pul, near Kerind, on March 4th: this seems early. Mr. Brotherston saw some between Ahwaz and Tehran on June 12th: and they are not uncommon in villages in Garrús and Azarbáiján, usually nesting on some ruined place in the middle of the village. The Persians call them *Hajji Lak-lak.*

Plegadis falcinellus (Linnaeus). Glossy Ibis.

1 ♂ Village of Fardis in Veramine: 12 m. E. of Tehran. September 30.
This was the only time I saw this bird in Persia.

Ardea cinerea cinerea Linnaeus. Grey Heron.

The common heron was often to be seen round Tehran: I skinned one shot at Veramine, 15 miles E. of Tehran, on the 7th October but did not keep the skin. I saw some at Bushire on the 12th December and Mr. Brotherston saw some at Kazvin on the 10th July.

On the 6th June I saw a number at the estuary of the Chalus river on the Caspian Sea: and on the 13th July one was fishing in the Lar river, much to the annoyance of trout-fishermen near by.

Ardea purpurea purpurea Linnaeus. Purple Heron.

1 ♂ Tehran Embassy. April 20th.
This bird was shot while fishing in one of the ambassador's ponds for goldfish.

Ixobrychus minutus minutus (Linnaeus). Little Bittern.

1 ♂ Tehran embassy. April 13th.
This little heron was also caught while extracting the ambassador's goldfish from one of his ponds. Its stomach when skinned, however, was empty.

Botaurus stellaris stellaris (Linnaeus). Bittern.

The bittern is said to frequent damp places in the district of Veramine, some 20 miles to the east of Tehran. I saw a carcase hung up in a shop at Tehran on the 6th December: the bird was to be sold for eating, and came from Veramine.

Phoenicopterus ruber antiquorum Temminck. Flamingo.

I saw a large flock in the sea S.E. of Bahrein island on the 17th December: I also have a note of flamingoes seen on Lake Rezaiyeh (formerly called Urumia) in the autumn.

Anser sp. Goose.

On March 14th a good many inhabitants of Tehran heard the honking of many gaggles of geese overhead during the night; some had also been heard on previous nights.

Tadorna tadorna (Linnaeus). Sheldrake.

1 ? Abadan: shot in November.

Casarca ferruginea (Pallas). Ruddy Sheldrake.

Mr. Brotherston reports seeing one near Ardekan on January 13.

Anas strepera Linnaeus. Gadwall.

Mr. Brotherston saw one at Ardekan on the 18th January.

Anas angustirostris Ménétries. Marbled Duck.

1 ? near Tehran. January 1.

Querquedula crecca crecca (Linnaeus). Teal.

Mr. Brotherston saw some at Ardekan on the 23rd January, and they are very common round Tehran in the winter.

Spetula clypeata (Linnaeus). Shoveller.

1 ♀ near Robat Kerim, 40 m. S.W. of Tehran. October 31.

Nyroca ferina ferina (Linnaeus). Pochard.

1 ♀ near Tehran. January 1.

Mergus albellus Linnaeus. Smew.

1 ? near Abadan. November.
Twenty-five tiny fish were in the gullet of this bird.

Phalacrocorax carbo sinensis (Shaw & Nodder). Cormorant.

1 ♂ near Tehran. February 23. In breeding plumage with white patches on the flanks. I saw several in Bandar Abbas and Bushire harbours in December, and on the Caspian Sea in June. It is curious that cormorants sometimes perch in the tall plane trees of the British Embassy compound: I saw them doing so in March.

Phalacrocorax pygmaeus (Pallas). Pigmy Cormorant.

1 ? near Tehran: shot on a pool in a garden near the town: February.
I suppose this bird was a stray from Gilan and the Caspian region.

Columba livia gaddi Zarudny & Loudon. Rock Pigeon.

1 ? Kamard near Jaja-rud.
This is the resident race which is very common all round Tehran, breeding in *qanát* holes and met with in almost every village.

Streptopelia turtur arenicola (Hartert). Turtle-dove.

1 ♂ Chal-harz, just north of Tehran. March.
1 ♂ Surkh Hissar, 10 m. E. of Tehran. May 14.
The second bird was apparently consorting with rosy pastors. Mr. Brotherston saw some turtle doves at Kazvin on the 5th August.

Pterocles orientalis (Linnaeus). Black-bellied or Imperial Sand-Grouse.

2 ♂ ♀ near Tehran. December 27.
These birds are fairly common in the winter: they seem to like feeding on or near to main roads. I saw a flock of about 20 near Sultanabad on the 9th December.

Charadrius alexandrinus alexandrinus Linnaeus. Kentish Plover.

I saw Kentish plover at Huleila, on Bushire island, on the 16th December: and also on the banks of the Lar river, at 7,000 ft., on the 29th July.

Charadrius dubius curonicus Gmelie. Little Ringed Plover.

I saw the little ringed-plover on the 29th July in the Lar Valley near Chihil Cheshmeh, in the bed of the river, with newly fledged chicks : chicks are hatched by July 14th. The bird is common on the Lar at that time, and its plaintive note is very frequently heard.

Erolia minuta (Leisler). Little Stint.

Seen at Dastak and Hulailah on Bushire island, 12th and 16th December.

Tringa totanus subsp. Redshank.

Seen at Dastak and Hulailah on Bushire island, 12th and 16th December.

Tringa ochropus ochropus Linnaeus. Green Sandpiper.

Seen in the Lar valley by the river Lar, and also by its tributary the Safid-áb, on the 29th July.

Vanellus vanellus (Linnaeus). Lapwing or Peewit

1 ♀ near Tehran. January 1.

The lapwing is fairly common on the plateau round Tehran in January and February. I saw one near Ahwaz from the railway, on the 17th February.

Chettusia leucura (Lichtenstein). White-tailed Plover.

I saw this bird at Hulaila, on Bushire island, on December 16th : and another at Abadan in February.

Scolopax rusticola rusticola Linnaeus. Woodcock.

1 ♀ Gulhek, 7 miles N. of Tehran. December 26.

Woodcock frequent the gardens north of Tehran from about the end of November : they are called in Persia usually *abyá*. I hear from a sportsman at Burujird that woodcock arrive there in November and December after the first frost : the birds come very thin but become fatter : Burujird seems to be a migrating centre for them.

Capella gallinago gallinago (Linnaeus). Snipe.

Snipe are to be found to the south and south-west of Tehran during the winter : a sportsman living at Kermanshah says they breed there.

Hydroprogne caspia (Pallas). Caspian Tern.

I saw a Caspian tern on the shore at Bushire on the 17th December.

Sterna albifrons subsp. Little Tern.

Mr. Brotherston saw a little tern at Ahwaz on the 6th June.

Chlamydotis undulata macqueeni (Gray). Houbara Bustard.

I saw a pair between Abadeh and Yezd-i-Khast on the 5th May : and Mr. Brotherston noticed one near Nain on the 2nd February.

Fulica atra atra Linnaeus. Coot.

Mr. Brotherston saw one between Ahwaz and Tehran on the 10th June.

Crex crex (Linnaeus). Corn-crake.

A corn-crake was found alive and kept alive for several days at the British Legation, Tehran : from July 12.

Tetraogallus caspius caspius (Gmelin). Caspian Snow-Partridge.

1 ♀ Elburz slopes north of Tehran : at 9,000 ft. February 21.

Alectoris graeca caucasica Sushkin. Chukar or Rock-Partridge.

1 ♀ Tochal mountains, about 15 m. north of Tehran, 7,000 ft. June 11th.

Alectoris graeca koroviakovi (Zarudny). Chukar or Rock-Partridge.

1 ♂ ? Kamard valley, near Jajarud, 15 miles N.E. of Tehran. January. These two birds were within a few miles of one another and it seems strange that they should belong to two separate races.

Ammoperdix griseogularis griseogularis (Brandt). Seesee Partridge.

2 ♂ ♀ 20 miles S.E. of Tehran. December 26.

This seems to be the race inhabiting the Elburz mountains and the vicinity of Tehran. Around Shiraz I think the bird is different and must be *A. g. termeuleni.* Zar & Loudon. I saw a family party of parents and several newly hatched chicks on the Tirak pass, between Mubarakabad and the Lar valley, on the 28th July.

Perdix perdix canescens Buturlin. Common Partridge.

1 15 miles E. of Tehran. Dec. 6. Fairly common in winter from here northward. The local name is *chil* or *kabk-i-chil.* It is a distinctly pale race.

Coturnix coturnix coturnix (Linnaeus). Quail.

1 ♂ near Safid-áb in the Lar valley. July 13.

I shot two quail but only found one: they were in the lush grass in an open space watered by an overflow of water from the river. 7,000 ft. A sportsman informs me that quail breed at Kermanshah and at Hamadan.

Phasianus colchicus talyschensis Lorenz. Pheasant.

These birds are resident in Gilan and Mazanderan, and are often sent up to Tehran for sale from these provinces. They vary in colour a great deal. The Persian word for them is *Qarqávul*, or in Gilan *turung.*

THE MOVEMENTS OF THE ROSY PASTOR IN INDIA

[*Pastor roseus* (L.)]

BY

HUMAYUN ABDULALI

(With a map)

The Rosy Pastor is well known as a non-breeding winter visitor to India and as a two-way passage migrant in the N.W. and in the Punjab. It enters and leaves India on a restricted front between the foot of the Himalayas and Central Baluchistan, travels over the high ground of North Baluchistan, Central and Northern Afghanistan and Persian Khorasan to the south-east corner of the Caspian Sea. Its breeding grounds lie in Russian Turkestan and westward to Turkey and beyond in S.E. Europe, normally as far west as Hungary. Beyond Indian limits it provides one of the most remarkable instances of east to west migration known among birds.

An attempt to determine its status and movements in the rest of India revealed a glaring paucity of information, and a circular inquiry was published in the *Journal* (Vol. 45, p. 228) as well as in the military news sheet *Contact* in an effort to collate fresh information and to have a clearer idea of its movements. There has been some response from members and others, but unfortunately all this information comes mostly from the Punjab, where its position is fairly clear. In a fresh effort to collect more information, the data now available is here summarized.

There is a solitary record of a male obtained at Lahul in Tibet on 1st July (*Ibis* 1925, p. 170) and another was seen on 6th July 1946 near Taklakot, 13,000, W. Tibet (Sálim Ali, *J.B.N.H.S.*, 46, p. 300). Stragglers occasionally occur in Kashmir, but the late Mr. Hugh Whistler has recorded (*Ibis* 1926, p. 579 and 1930, p. 105) that the migration passes into India south of the Kangra Valley and also misses the Rawalpindi District in North Punjab. Southwards through Peshawar, Jhelum, Gujranwala, Lahore, Firozpur, Patiala, Saharanpur, Amballa and Delhi it is exceedingly common on passage, the autumn migration commencing early in July, reaching its peak towards the end of July and petering out in September, (Lt.-Col. J. A. L. Cowie (*in epist.*) saw the last birds at Lahore on 8th September. They were in attendance on grass cutters). The return passage makes itself felt towards the end of March and is most pronounced during the first half of April. By the end of April they are gone, though a few may be seen early in May. In autumn and spring, birds are observed moving south-eastwards and north-westwards respectively. Major General Hutson has recently dealt in detail with the status of this bird around Delhi and has noted them feeding on the berries of *Salvadora persica* and on the black berries of *Capparis sepiaria* (*Ibis* 1945, pp. 275-279. In *J.B.N.H.S.* ix (p. 66) is a reprint of a note by E. C. Cotes on the Food of the Rosy Pastor first published by the Indian Museum. It is said to do a large amount of destruction to locusts of which many more are killed than eaten.

In Sind, Baluchistan and the North-West Frontier Province, the position is almost identical, and is dealt with by Ticehurst (*Ibis* 1922, pp. 616-618). It first makes its appearance in the Quetta Valley about the middle of July and passes through *en masse* in early August. Large flocks again appear in April and the birds are seen upto the middle of May. Ticehurst specifically states that it does not winter in British Baluchistan but that stray birds are seen on the Mekran coast. Currie (*J.B.N.H.S.* xxiv, p. 564) in his notes from Lahore confirms the two-way passage migrations and says that 'scattered flocks may be met with throughout the cold weather' and this is perhaps the correct status for the areas already dealt with. At Bahawalpur Major Atkinson (*in epist.*) says they are found in great abundance from about the middle of July to October when the dates are ripening and the Bajra is in seed. It returns (Sir R. M. Crofton, I.C.S. *in epist.*) in large numbers in the second week of April, being chiefly interested in pipal fruit and wheat gleanings. Ralph Stokoe (*in epist.*) found it common in Jaipur on 7-9th October, 1945.

There is general agreement among all observers that more immature birds appear in autumn, and Magrath (*Ibis* 1909, p. 131) in his notes from Kohat maintains that 'immature birds stay as late as November.' Currie notes that the autumn migration is more leisurely and observers are also agreed that when the return migration reaches its peak, there appears to be an attendant increase in the intensity of purpose in the movement. In spring, the movements in the north-western area coincide with the ripening of mulberries and corn.

Moving southwards, Sálim Ali in Kutch noted them on his arrival there on 5 August, and was informed that they had already been there for about a fortnight. His notes indicate that large numbers were present on the 15th August, but thereafter, their numbers declined and were far fewer when he left Kutch on 3 October. On his return on the 3 March a few birds were present. They increased until large numbers were again seen on the 25 March all flying in a north-westerly direction. They were noted as partial to the fruit of *Cordia Rothii*, *Premna coriacea* (?) *Capparis aphylla*, *Salvodora persica* and *S. oleoides*, and were also devouring large numbers of carterpillars.

For the large area of Rajputana, Kathiawar, Central India, the Central Provinces and Peninsular India in general, we have only the statement made by numerous observers that it is a 'winter visitor'.

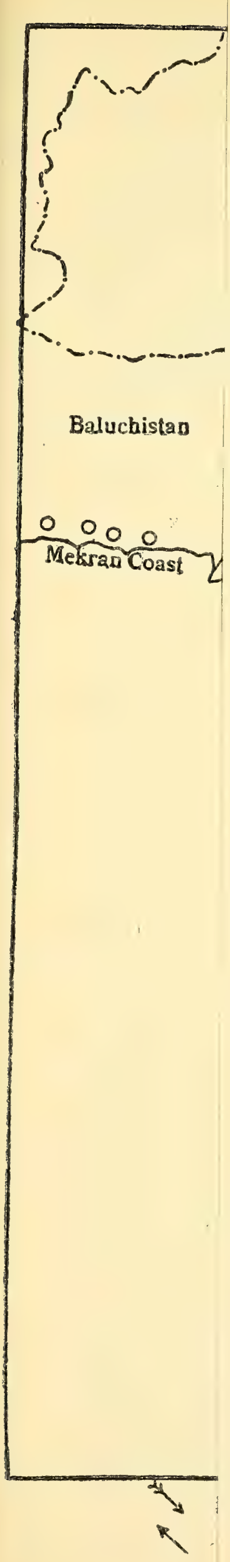
In the forested areas like Balaghat (D'Abreau, *J.B.N.H.S.* xxi, p. 1165) and Pachmarhi (Osmaston, *J.B.N.H.S.* xxviii, p. 455 'some flocks in spring'), the records appear to indicate their arrival much later than further westward. In Bhopal, Whitehead (*J.B.N.H.S.* xxi, p. 155) records that 'large flocks pour in as the Jowari ripens towards the end of November' and indicates the earliest date as 17 October. Sálim Ali had not noted them when he left Bhopal on 29 September though he records them in Gwalior on the flowers of *Butea frondosa* from early January upto the 16 April (*J.B.N.H.S.* xli, p. 99).

Briggs (*J.B.N.H.S.* xxxv, p. 389) at Mhow records several large flocks in March and also one in January, two in February, and four in April.

In Berar, Mrs. Wright (*J.B.N.H.S.* xliii, p. 434) classes it as a 'common winter visitor especially to the plains, first recorded on the 23rd September'. She adds that 'by the end of February when *Butea frondosa* was in full bloom their numbers appeared to increase. They were last seen on the 31st March when they disappeared suddenly'.

In Gujarat, Sálim Ali noted them commonly between 27th October and 30th March feeding largely on peepal figs, *Salvadora* berries and Jowar.

In Bombay, it ordinarily arrives in the middle of October (was noted on 20 August 1939, which was a drought year in Gujarat and Kathiawar, as also a pair in immature plumage on 28 August 46). Their numbers increase with the flowering of *Bombax* and *Erythrina* in January and they are abundant until mid-April. The fruit of *Mimusops hexandra* is also largely eaten. Jerdon (ii, p. 333) says it usually makes its appearance in the Deccan (where Burgess found them feeding on the flowers of the leafless caper) and Carnatic about November, associating in large flocks and committing great devastations on the grain fields, particularly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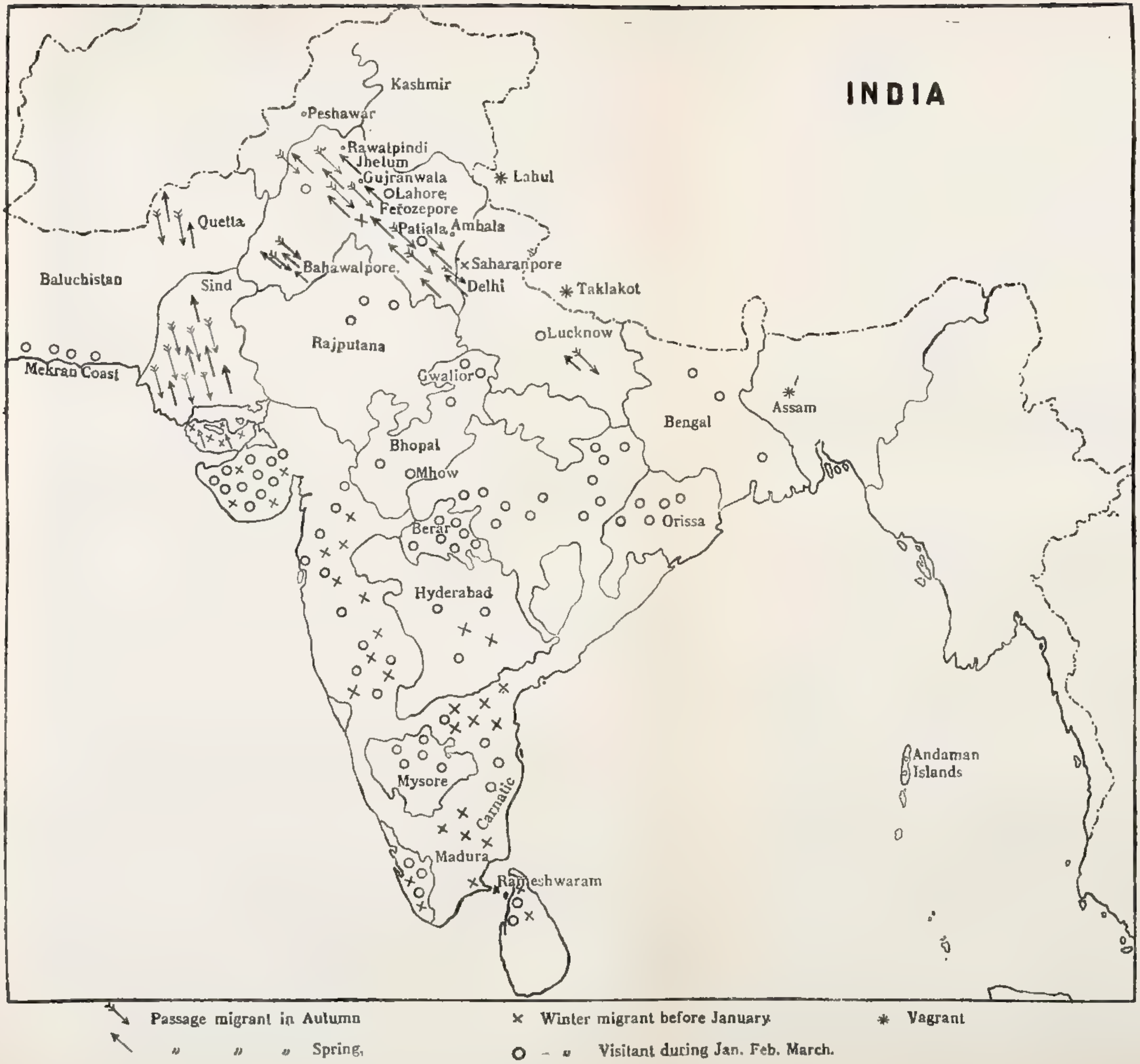
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Bahawalpore
Saharanpore
Delhi
Taklakot
Baluchistan
Sind
Rajputana
Lucknow
Mekran Coast
Gwalior
Assam
Bengal
Bhopal
Mhow
Orissa
Berar
Hyderabad
Andaman Islands
Mysore
Carnatic
Madura
Rameshwaram
Passage migrant in Autumn
" " " Spring
Winter migrant before January
" Visitant during Jan. Feb. March.
Vagrant

Movements of the Rosy Pastor in India.

jowari. Sálim Ali saw large flocks in Warangal in February and in the Nander District late in March.

Continuing southwards, Davidson (*J.B.N.H.S.* xi, p. 666) records them in North Kanara as 'a cold season visitor both above and below the Ghats but only seen occasionally in small flocks'. This is amplified by Koelz who was in Londa from 7 January to 13 March (*J.B.N.H.S.* xliii, p. 19) and noted 'small parties of half a dozen or singly in fields'.

In Mysore (*J.B.N.H.S.* xliii, p. 579) Sálim Ali noted them only in Nov./Dec., but Taylor (*S.F.* x, p. 454) writes 'plentiful in the plains, but very few in hill tracts'. The species is omitted from Betts's 'The Birds of Coorg' (*J.B.N.H.S.* xxxiii, p. 542), nor is it recorded from the Palni Hills (*S.F.* v, 387-410; x, 467-480).

Presumably following the birds which passed through Delhi in July/August, we come to George Reed's notes in *Stray Feathers*, Vol. x, p. 54 from Lucknow. He found them fairly abundant in early October, and holds that vast numbers are seen from the middle of February to the end of April. Osmaston does not mention it in his 'The Birds of Gorakhpur' (*J.B.N.H.S.* xxii, p. 568). Lt.-Col. J. A. L. Cowie (*in epist.*) saw a few birds on the Red Silk Cotton in flower on 13 February 1946 at Lucknow.

From Chota Nagpur and Orissa, Ball (*Stray Feathers*, Vol. ii, p. 419) records it in February 'wherever there are cotton trees *Bombax malabaricum*'. The localities covered by his paper were Lohardugga, Sirguja, Gangpur and Sarunda, Sambalpur, west of Mahanadi R., Orissa north of Mahanadi, Nowalgarh and Karial, Raipur. He quotes Capt. Beavan noticing large roosting flocks at Purulia as late as April. It is very rare in Bihar, Inglis quoting one shot on 14 December and a few seen in March in the Madhubani sub-division of the Darbhanga District (*J.B.N.H.S.* xiii, p. 629) Jerdon quotes Blyth that 'they visit the neighbourhood of Calcutta only at the end of the cool season, when flocks of them are not unfrequently observed on the arboreal cotton tree then in bloom'. It is not listed by Inglis from Jalpaiguri Dist. (*J.B.N.H.S.* xxvi, p. 988). Stuart Baker got one in Assam.

South-eastwards they were not noticed by Humayun Abdulali at Vizagapatam in the North Madras Presidency during a week's visit at Christmas (*J.B.N.H.S.* xlv, p. 333).

From Madras the only information is Dewar's who records it without dates as 'not common' (*J.B.N.H.S.* xvi, p. 48). Biddulph (*J.B.N.H.S.* xl, p. 243) at Rameshwaram Island noticed small flocks in Dec./Jan./Feb., mostly in December, presumably on passage to Ceylon where it is a winter visitor. ['Sometimes large flocks' (Waite).] Layard's statement that one year in Ceylon he saw large flocks in July for a week is quoted as unusual. (Jerdon ii, p. 335.)

In the Andamans, Col. Tytler's statement that several arrive in flocks in January has been discredited by A. L. Butler who holds that 'it is an accidental visitor'. Osmaston twice saw flocks and shot three specimens in these islands (*Fauna of Brit. India*—Birds, iii, p. 30). This is very remarkable because there are no records from Burma, so this migration presumably being from India over a long stretch of water.

In the Madura District, Nichols records them from 21 October to 12 April occasionally in flocks of upto 400 birds. Here it is known as 'chōlam-batchi' (jowari bird). (*J.B.N.H.S.* xliv, p. 401).

In Travancore, Ferguson recorded them as common between September and March. Sálim Ali saw only a few from December to February (*J.B.N.H.S.* xxxviii, p. 500).

This rough summary gives a general idea of the mass entry into India, a subsequent dispersal followed by another massing for return. Considering the large numbers in which they swarm into India, their movements must, to a large extent, be regulated by the availability of food. In the plains and cultivated areas, the ripening of wheat, jowar and other crops are the controlling factors while where they occur in smaller numbers, they depend on the flowering of the well known ornithophilous trees like *Bombax malabaricum, Erythrina indica* and *Butea frondosa.* They also eat the fruit of the pipal (*F. religiosa*) *Lantana camara, Salvadora persica, Mimusops hexandra, Capparis aphylla* and *sepiaria* and *Phoenix sylvestris.*

To map out their movements more precisely it is necessary that observers not only keep careful notes of the arrivals and departures of this bird in their area, but also try and correlate them with the availability of their food, which must always be abundant and is usually conspicuous. We hope that members and others will continue to send in notes and observations to complete this investigation.

REVIEW

MEMOIR OF THE ANGLER'S CLUB. MADRAS, 1946.

This attractively got-up *Memoir* affords a pleasing insight into the activities of the Madras Fisheries Department, for it was on the initiative of officers of the Inland Development Section that the idea of founding this club was evolved with the laudable aim and object of offering to the angling public the benefit of sport (and science) on an organized footing.

Inaugurated on the 15th August 1945 the club has His Excellency the Governor of Madras as Patron, and 27 Members, of whom eight are officials of the Fisheries Department. There will no doubt be active and continuing efforts on the part of members to rapidly increase their number (entrance fee Rs. 15/-, monthly subscription Rs. 2/-) and popularize the movement. To a keen angler, membership offers several important advantages as will be quickly realized by those who join the club.

Perhaps in course of time the club will expand to include as Associate Members the many along the coasts and inland who are keen though humble anglers and able to afford only a lesser fee. Is it not possible in these days of co-operative movements, that through such extension of activities and ideals of the club, some very considerable assistance might not be afforded to the rather uphill efforts of the Fisheries Department to check the immense devastation caused among the fish of many species, more especially those of narrow and shallow waters where plyers of small meshed nets, and other destructive devices spare not even the tiniest of fishes? Humble Associate Members of the club, once enrolled, suitably informed and organized might in course of time be the means of creating that proper public opinion which is so essential. This once aroused could become a very strong force to condemn and control the many wasteful methods militating against the sport of the angling fraternity and such major mal-practices as dynamiting and wholesale destruction of fry on spawning grounds, which so very greatly lessen the potential supply of much needed protein food to the many millions who so badly need it. From small beginnings great things can result. This idea of your Reviewer is offered in a friendly and helpful spirit.

The list of Angling Spots in the Madras Province contributed by Mr. P. I. Chacko will be appreciated by both freshwater and sea anglers and will doubtless be continued in future issues of the *Memoir*. The several articles contributed by other members are interesting and helpful. It is suggested that it would also be mutually helpful were anglers to note down and report the local vernacular names of different species, for names of fishes vary even within the limits of a single district.

The photograph of the 7 lb. Mirror Carp taken in the Sims' Park Lake, Coonoor, is of particular interest to many members of the Bombay Natural History Society in view of the article on this fish published in the April 1945 issue of the Society's *Journal*.

Congratulations are due to those who have so obviously worked hard to establish this club, believed to be the only Association of its kind yet formed in India, the scope for expansion of membership and activities of which is almost unlimited.

R.W.B.

THE BIRDS OF NORTHERN THAILAND. By H. G. Deignan, United States *National Museum Bulletin* 186. Smithsonian Institution, Washington, D.C.

This is a belated notice of a comprehensive paper concerning the Birds of Northern Thailand, published in 1945.

It has been the practice of our *Journal* to publish papers on the fauna of a district in many parts, often spread out over a period of years. This renders them difficult of access and considerably lessens their value as works of reference. A look at this volume endorses the suggestion recently made that the Society should also issue bulletins of this kind, for though they would have relatively little sale value, as works of reference they would certainly be worth the additional cost.

Our attention is first drawn to the systematic arrangement of the various families and genera, where in strange contrast with the *F.B.I.* Birds volumes, we begin with the Grebes, Pelicans and Vultures and conclude with the Sunbirds and Buntings. Our systematic arrangement is admittedly obsolete and the new edition of the *Fauna* must come into line with the modern international practice.

There is also the inevitable reshuffling of generic and specific names and the field ornithologist begins to wonder if it is any use trying to keep in touch with the so-called correct name of a species. That very distinctive bird, which we have known for many years as *Lyncornis,* now becomes *Eurostopodus. Kittacincla* is merged in *Copsychus,* and the races have again been reshuffled. *Saxicola caprata burmanica* has been resuscitated as different from *caprata* on the ground that the adult females of the former have darker underparts. *Anthus richardi* and *rufulus,* which were so painstakingly separated, are now said to be bridged by the form *sinensis* and therefore cannot be considered separate species. Any critical examination of the systematics of the work is outside the scope of this review and we can only refer to the several notes which are particularly interesting to the Indian ornithologist.

It is strange that in spite of the care and trouble taken over the preparation of this work, the author has omitted to record the measurements of the various forms and merely states that one is larger or smaller than the other.

An attempt has been made to retain popular names in keeping with the scientific ones, and we have poly-syllabic words like 'Szechwanese Slaty-crowned Redstart', 'Tenasserimese Red-whiskered Bulbul', 'Holarctic Short-eared Owl', and so forth. The popular name now becomes as difficult as the scientific one, and no useful purpose is served.

There are many references to habits of birds which are interesting to the field worker in India. It is maintained again that the King Vulture has priority over *Pseudogyps* at meals. The gland in the middle of the back of *Hemicircus canente* is said to be 'the origin of the buffy or greenish yellow colour with which the plumage is suffused, and which can be washed off in a newly killed specimen'. The author stresses the fact that *Hirundo striolata sub-striolata* (this is what we know in our area as *H. daurica nepalensis* !) roost on wires instead of among reeds, as do the other swallows. Large numbers visit Peninsular India during the cold weather, and can be seen strung out in long lines along the telegraph wires. We wonder where they settled before these man-made roosts became available.

There is an interesting note on the manner in which the two Nuthatches, *S. castanea* and *europaea* appear to be representatives of the same species which have split into two groups occupying distinct ecological niches, the former occurring at low levels and the latter holding the high summits. There is reference to flocks of twenty or more of Leaf Birds (*Chloropsis aurifrons*) which we have not noticed in India. Three species of *Chloropsis* are also said to occupy distinct types of forests which are unfortunately not described in any detail. They are said to feed only on nectarivorous insects, but we have no doubt that they drink the nectar also.

The Red-whiskered Bulbul is said to be the only bird 'which shows real interest in the seeds of the Lantana', but in India, at all events, many other birds devour large quantities, e.g. Rosy Pastors, Babblers, Grey-headed and Brahminy Mynahs, Spur Fowl, etc. The same bird is said to occur in loose flocks composed of hundreds and it is possible that when in these numbers they might eat the largest quantities of Lantana seeds.

There are some interesting notes on the *Criniger* group of Bulbuls, but it does not appear that the last word has been written on this matter.

Young *Copsychus saularis,* throughout Thailand, have more black on their rectrices than their parents, in whom the black decreases from the south to the north. This is interpreted as indicating that the northern form has been derived from the south. An item of this nature only goes to show the large amount of systematic work yet to be done with a full series of specimens, which we are sure, will be more interesting and valuable than the description of new races on the strength of one or two specimens.

The author refers to a Red-breasted Fly-catcher occupying the same perch each cold weather. Our old shikar books talked of small jungle patches, where you could shoot a tiger one year, and find another in residence in the following season. Birds appear to have the same predilection for perches and haunts. An attempt to find the actual factor which draws them to the same place would be of interest.

The local distribution of *Rhipidura aureola* is said to be linked with that of *Tephrodornis pondicerianus* and it would be interesting to compare their habitats in India.

The Indian Mynah has established itself in Thailand in recent years, as in several other parts of the world, where it was introduced.

Sturnus malabaricus nemoricola is said to be an extremely variable form subject to both albinism and erythrism, often in the same individual. *Three* adult Munias are recorded as having fed young birds which dropped out of one nest. Bayas are said to nest more often than not in the same trees as red ants of the genus *Oecophylla,* which we have not noticed in India, possibly because here the Baya builds usually on date palms, Tamarind or Babul trees, none of which has leaves of which the ants could build a nest. We have, however, often seen nests of Sunbirds quite close to the ball-nests of *Oecophylla,* particularly in mangoes.

This is a compendium of all available knowledge of the birds of a very interesting area—the meeting place of many Indo-Chinese species, several forms of which have again got isolated in the hilly areas and have broken up into geographical races. Though a revision of the Indian avifauna would be a much larger and more difficult job, we hope that those who take up this gigantic task where it was left by Ticehurst and Whistler, will follow the thoroughness of this work.

H. A.

FAR RIDGES. By J. K. Stanford. Pp. 208. 21 half-tone plates. C. & J. Temple Ltd., London, 1944. Price 16*s*.

Far Ridges is at first intended to be a passing record of the meandering of the Vernay-Cutting Scientific Expedition during the winter of 1938-39, through the little known country of Northern Burma where the naturalist and traveller will find many a surprise awaiting him, more so, if he is prepared to face the country through its climatic changes. *Far Ridges* is but an appetiser.

Major Stanford was an ornithologically minded member of the Civil Service who had spent many years in Burma and finally ended up as Deputy Commissioner of the Myitkyina District, which borders 'No man's Land'. He retired from service without the hope of ever revisiting the area of his official labours. But Fate had decided otherwise. Through some turn in the wheel of Fate he joined the Vernay-Cutting Expedition as ornithologist. Both Arthur Vernay and Suydam Cutting are well-known explorers, hunters and travellers.

The author gives us a glimpse of the details necessary before an expedition actually moves out into the field, the unseen snags and obstacles to be overcome before the start, and the 'forgottens' after the start. He humorously gives a picture of the journey out from England to the place of *rendez vous* of all the members of the expedition, and its personnel. He was once the Deputy Commissioner of the area the expedition was passing through, now, just J. K. Stanford he cannot help reflecting on the difference of reception. Now he returned as an ornithologist and traveller, not to be troubled any more with the drudgery of administration.

In the chapters that follow, the ornithologist is uppermost, but details of the country and the local people are not missed, nor the sidelights of camp life.

The book, besides being a readable narrative of the work of the expedition, is an ornithological record of the bird-life of the area visited—a record of many new finds of scientific importance. Since this expedition, Burma passed through the rigors of a dreadful war which spared not even the remote jungles. Perhaps vast tracts have been destroyed which time alone will heal. Those interested in the ornithology of Burma will find Major Stanford's article 'Some suggestions for field Ornithologists in Post-War Burma' in the *Journal of the Bombay Natural History Society* (Vol. xlvi, p. 478) most enlightening.

The book contains good photographs showing various aspects of the country and people.

C. McC.

APPEAL.

The Odontological Museum of the College of Surgeons require skulls of monkeys and other animals—particularly that of the Lion-tailed monkey (*Macaca silenus*). If you could help in the matter would you please write to :—

Sir Frank Colyer, K.B.E.,
39, Palace Road,
Streatham Hill,
London, S.W. 2.

RESEARCH REQUEST.

I am interested in obtaining reprints, copies of unpublished manuscripts and results or observations made in connection with the biological control of mosquitoes.

I want to bring this information together in the form of annotated bibliographies.

J. B. Gerberich,
Dept. of Biological Science,
Michigan State College,
East Lansing, Michigan, U.S.A.

MISCELLANEOUS NOTES

1.—THE SENSE OF SMELL IN TIGERS

With reference to Mr. Meston's letter in the April 1946 number of the *Journal*, the following experience may be of interest although it does not give a definite answer to the question. I have shot a number of tigers and many leopards, and only in this one case, that of a tiger, have I noticed any evidence of a sense of smell in these animals.

This happened in December 1938 in the Mangaldai district of Assam. This tiger had killed a cow in a bamboo plantation and my shikar chair was put up in the centre of a thick clump of bamboos, very well concealed, and about ten feet high. The tiger came along very noisily about 8 p.m., strode up and down and round about for a short time, came noisily up to the foot of my bamboo clump, sniffed very loudly about half a dozen times, and then cleared right off, also very noisily, never having gone anywhere near the kill. I do not think it could possibly have seen or heard me.

I shot this same animal about a week later over another kill, which was on open ground. I sat this time on a small platform constructed inside the edge of *Eupatorium* or 'giant *Ageratum*' scrub jungle, well concealed by *Eupatorium* bound all round the platform which was about three feet above ground. This time he was much closer than previously, but showed no signs of scenting me and was shot at a range of about fifteen feet, as he stood on a slight ridge overlooking his kill and the open country. Weather conditions and time of arrival appeared much the same as before.

I knew this to be the same animal as he was one of three—two tigresses and this tiger—having come into the garden and killed nearly one hundred head of cattle. The two tigresses were shot first, one over a kill, and the other stalked and shot in a river pool, and the tiger as described, the last of the lot and that finished the destruction.

Not very satisfactory, but there you are.

TEOK T. E.,
TEOK P. O.,
ASSAM.
28th October, 1946.

T. E. H. SMITH.

[Mr. R. C. Morris's comments on Mr. Smith's note are of interest. He writes:—

'The experience described in the second para of this letter exactly bears out my views that a tiger, and a panther for that matter, has a hound (ground) sense of smell only but I do not believe that they have a 'winding' sense of smell as deer, antelope, bison, buffalo and bear have. I have had many similar experiences myself; chiefly owing to the fact that the shikaries who erect the machans *will*, unless supervised, leave their blankets and coats lying on the ground near the machan tree. It is most difficult to get them to hang their belongings on to branches of other trees. The result is that a tiger comes along and gets the scent of the clothes, etc. that had been lying on the ground, becomes suspicious and goes away.'—EDS.]

2.—DESTRUCTION OF CATTLE BY TIGER *EN MASSE*.

A recent instance of two tiger killing eight of our grazing cart-bulls at midday reminded me of Jim Corbett's excellent book '*Man-Eaters of Kumaon*' and the equally good review of this book by R. W. B. In his book Jim Corbett writes that a case of a tiger having killed without provocation more than was needed to satisfy its hunger had not come to his notice. Quite apart from the killing of eight of our grazing cart-bulls, I know of at least five similar instances in which the numbers killed varied from 7 to 15; in one case only were the cattle enclosed; the remaining four instances being day-light occurrences.

I entirely agree with R. W. B. also in respect of his para. on leopards and porcupines; I think leopards get stuck by porcupines just as often as tiger. Lastly, although Corbett has not known of man-eating leopards killing human beings by daylight R. W. B. is quite correct in saying that this has not been the case in other parts of India nor, I may say, in Ceylon; e.g. the famous Ponani man-eater (a leopard).

17, AURANGZEB ROAD,
NEW DELHI. R. C. MORRIS.
4th November, 1946.

3.—FIVE SHOTS WITHIN TWO HOURS AT THE SAME PANTHER.

Mainly because I did not expect any ordinary individual to believe this incident, have I failed to put it into print before. To-day I feel old enough to shoulder any ridicule which might be forthcoming from the 'unbeliever'.

Whilst planting in Travancore, it happened that my assistant and his wife were returning to their bungalow, when on the road just below ours, they spotted in the beam of their somewhat dim lights, two eyes which to them appeared to be those of a tiger. Returning to our bungalow, I got my ·500 and went down to investigate. The two 'eyes' were still in the same place. After firing we inspected the spot and confirmed the pug marks of a panther. It meant turning the car lower down the road. On the return journey, the lights again picked up a pair of 'eyes'. Another shot, and a clean miss. Knowing our own car carried a spot-light with a 500 ft. beam, we decided to have another try. Running the spot-light over the Red Gum clearing where the panther had been seen, the beam picked him up some 50 yards away. (By the way another planting friend, together with my 12 bore and lethal, accompanied us on this mission.) Shot number three,—a clean miss. Turned the car, and on the return journey, found the compounder standing near his house, and no doubt wondering what the bag of hares amounted to. More in temper than meaning it, I shouted to him to tie up a damned cow. Back to the bungalow and dinner! No sooner had we started soup, when the compounder sent word to say his cow was being killed.

Three of us were soon down on the road again. After finding the kill, in the beam of the spot-light, we proceeded to await events. The spot-light was switched off, but at the same time trained on the 'kill'. After some five minutes a stone had been dislodged, and came rolling down towards the car. My friend switched on the light, which found the panther lying alongside the cow. From me, Bang! Hell! and miss.

Back to dinner in all earnest this time. Halfway through the meal, I suddenly had a 'hunch', If he'll come back four times, why not the fifth? Three of us again went down to the kill. The spot-light showed no intruder, so we decided to wait for a while. After perhaps ten minutes a noise was heard in the vicinity of the 'kill', less than forty yards away. This time I meant to throw all caution to the wind, so stepped in front of the spot-light before it was switched on. The light was then switched on; and found his lordship sitting on his haunches at the side of the kill. Like the previous four shots, it was a 'sitter', but of course with the light at the back of the sights, it made all the difference. This time he toppled over and rolled towards us, until finally held up by a drain. In this, he struggled for a second or so, until my friend fired a lethal bullet at him. The skin was in no way damaged, but in case my friend reads this article, I think he probably gave the stupid panther the *coup de grâce*. A perfect specimen of a male panther, with no outward signs of any previous wounds. Could he possibly have been stone deaf? It is difficult to put any other construction on his persistent folly of remaining in the area after having been shot at four times prior to the final shot.

CLOUDLAND ESTATE,
CUMBUM P. O., H. GIBBON.
MADURA, S. I.
6th January, 1947.

4.—REVERSAL OF FEEDING HABITS IN A DEER AND A DOG.

Conditions of captivity may bring about extraordinary changes is the habits of animals.

A deer and a dog were kept as pets for three years from their early days. Curiously the distinction between their feeding habits vanished. The carnivorous dog swallows vegetables (cabbages, cauliflower, and peels of fruits), with great pleasure and the herbivorous deer relishes the flesh of a goat. Now they are great friends with each other. One will not eat unless the other is present and vice-versa.

Vegetable feeding among dogs is not so uncommon and may be seen both in the wild state and under domestication. But for the deer, which was caught in the forest when probably 3 weeks old and reared under captivity, its abrupt change to a carnivorous diet is perplexing. How its digestive system could accommodate such a complete change in food, is unexplained. How an unaccustomed protein meal is digested by its normal gastric secretion is unknown.

The author will be thankful to his learned readers for an explanation.

These two curious pets belong to Mrs. K. L. Lahiry; to her the author's best thanks are due.

ZOOLOGICAL LABORATORY,
UNIVERSITY OF CALCUTTA,
35, BALLYGUNJ CIRCULAR ROAD,
5th November, 1946.

SIVATOSH MOOKERJEE.

5.—NATURAL DEATH OF ELEPHANT.

Your comments contained in the last paragraph of the *B.N.H. Journal* for August 1946, under the above heading, rings a comforting note in my memory.

Whilst lecturing on Jungle Lore in the capacity of Commandant of No. 2 Jungle Training School in Ceylon during the war, I could always rely on one of the 'grand lads' putting forward the usual chestnut! 'Where do elephants go to die? and do they resort to a common burial ground? My reply coincided almost verbatim with your comments; with the following addition. 'Excepting thigh and skull bones, I have known a fully grown dead cow elephant completely disappear within a period of two months.' Although the putrefying flesh and blood killed the grass and vegetation over the area on which the carcase lay, within a short time,—no doubt due to phosphates and other mineral properties,—this grass and vegetation eventually grew to a greater profusion than previously. This, I think, largely accounts, in addition to your factors, for the lack of evidence where the death of large animals is concerned. Burial grounds. This to my mind is mythical!! Where traces of large collections of animal bones have been found; more especially in the case of pre-historic findings, this I attribute to one of the following causes. (1) Disease. (2) Land-slide. (3) Trapped in a glacier.

Although not necessarily portending death, all animals when feeling 'off colour' naturally seek seclusion. How often have we seen this instinct put into practice where our own domestic pets are concerned?

CLOUDLAND ESTATE,
CUMBUM P. O., H. GIBBON.
MADURA DIST. *F/Lt.*
7th January, 1947.

6.—THE SIZE OF INDIAN ELEPHANTS.

I send you herewith details of some large elephants that have been shot in India within recent years. As long ago as 1886 (vide *The Statesman* of February 23rd 1886) the question of the 11′ Asiatic elephant was exercising the minds of sportsmen and others, and the late Mr. G. P. Sanderson had not measured any larger than 10′ 6½″ high at that time. In recent years I have measured two large tuskers, one belonging to the Raja of Gauripore, Assam, which was 10′ 4½″ at the shoulder and the other belonging to the Maharajah of Gwalior, which is 10′ 5″ at the shoulder. I doubt if there is a larger elephant than this in captivity to-day, unless it be found among those owned by the Maharajah of Nepal.

But while the existence of a captive 11′ elephant is still to be proved, I have no doubt that such elephants exist in the wild State. Very recently an animal was found dying in the forests of Kachugaon, Goalpara District, Assam, and was measured by a Forest Officer after death and found to be 11′ high. His tusks were as follows:—

1. 8′ 0″ long, 1′ 4½″ thickest mid-girth. Weight 1 md. (82 lb.)
2. 8′ 0″ long, 1′ 4¾″ thickest mid-girth. Weight 1 md. 14 chattaks (84 lb.)

This elephant, I think, constitutes an all-round record for the Asiatic elephant, and I shall be interested to know of any bigger.

The present Maharajah of Mysore claims to have shot an 11′ elephant in his State. This animal, a photograph of which appeared in *The Illustrated Weekly* in 1940, had tusks which weighed 162 lb. all told though they were a little over 6′ in length.

The present Rajkumar of Gauripur, Assam, shot a makhna (tuskless male) in the Garo Hills of Assam in 1945, the fore-foot of which measured 5′ 6″ in circumference. It was not possible to measure the shoulder-height of this animal as it lay in an awkward position.

Coming to elephants below 11′ in height, the late Mr. P. R. Phukon of Gauhati, Assam, shot a tusker in the Khasi Hills of Assam in 1938 which measured 10′ 10″, Mr. Gyles Mackrell shot a tusker in the Haltugaon Forests of Goalpara District which was 10′ 9½″ in height, while the undersigned shot one in Kachugaon in 1940 of which the measurements are given below :—

Height—10′ 8½″.

Tusks: 1. 7′ 3″ length. 1′ 6½″ thickest girth, 77 lb. weight.
2. 7′ 1″ length. 1′ 6¾″ thickest girth, 77 lb. weight.

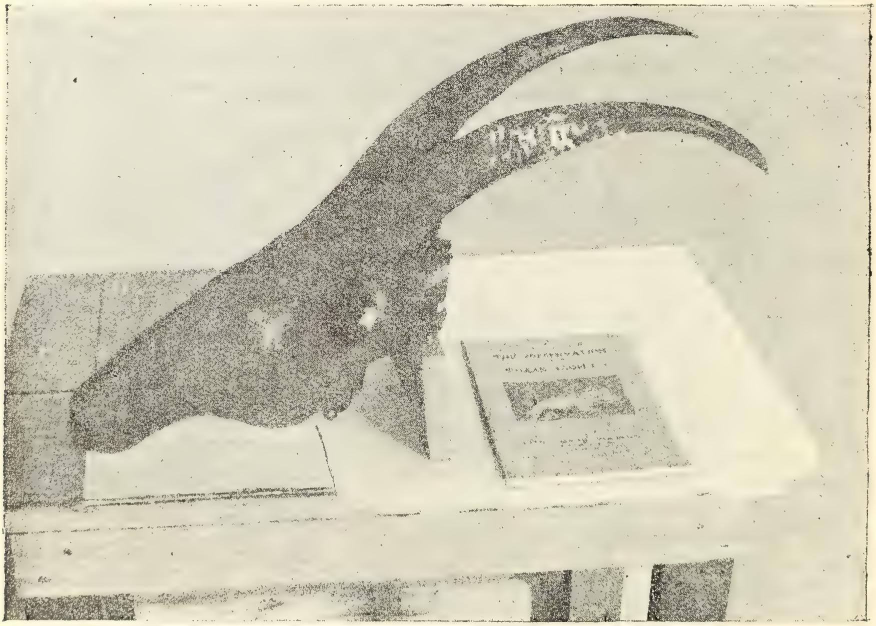
In estimating the above weights, a maund is taken to be 82 lb. in weight.

CONSERVATOR OF FORESTS,
SHILLONG, ASSAM. P. D. STRACEY, I.F.S.
15*th October*, 1946.

7.—RECORD SEROW.

(*With a photo*)

Major G. T. Allen, M.C., Assistant Political Officer, Lohit Valley Sadiya, has sent us a Serow, which he states he discovered in a hunter's house in the Mishmi Hills in North Assam which is very likely the record.



RECORD SEROW HEAD

The measurements are—right horn—12¼″.
left horn—13⅛″.

We enclose a photograph of the head and should be grateful if you would record this in the *Journal.*

ARTISTS IN TAXIDERMY.
MYSORE. VAN INGEN & VAN INGEN.
3rd October, 1946.

[The longest horns so far recorded of the Eastern race of the Serow measure 11½ ins.—a head obtained in the Mishmi Hills by R. L. Sinclair. (Rowland Ward).—EDS.]

8.—'SHAMMING DEATH'

Mr. Dunbar Brander's note on this subject (Vol. 46, No. 2, p. 399) will doubtless attract attention of naturalists and sportsmen.

During the years when I hunted my Bobbery Pack in the Hyderabad Dominions the jackal's habit of 'shamming death' was sometimes observed by me and my companions of those days. The animal would allow itself to be mauled, hauled about and left for dead—except when Prince, or Tiger, or Paddy, or Poligar Bob had been at him!

When the jack found his simulation of death through immobility and non-resistance had caused his assailants to leave him he was up and off, to be perhaps caught a second time and truly slain. But he was not always caught, not if there happened to be sufficient near-by cover for his escape. In all those instances the animal was in imminent danger of death by violence, or died by violence, but no death cry was ever heard.

All of us have noticed the numerous instances among insects, caterpillars, beetles and other crawling creatures of immobility when touched, an obviously instinctive action by which further molestation is frequently avoided. That, in common parlance, is also 'shamming dead' or, shall we say 'playing possum'.

The 'death cry'. I have not anywhere read of death cry of a tiger being remarked upon. That comforting assurance of demise of a tiger shot at from a night machan has three times been heard by me. Twice a male (4.2.25 & 15.3.26) and once a female (7.4.25) all full grown animals and subsequent to the first memorable reading of Mr. Dunbar Brander's *Wild Animals in Central India*, or it would have been then mentioned. This cry is not made by all tigers wounded to death.

It is a loud cat-yowl unmistakably similar to the dying yowl of a domestic cat killed by dogs, which I have unfortunately heard in two unintentioned instances. It is curious that no panther has been heard to utter this death cry, which is most certainly, in case of the tiger, unlike any sound ever made in the course of his life until his dying moment had arrived.

I have never observed simulation of death on the part of any tiger or panther, but an acquaintance, the son of the Imperial Forest Department student, who was mauled by the man-eating tigress of Mundali on the 7th May 1889, pulled the tail of a supposedly dead panther and was thoroughly 'combed' down by the enraged beast. It cannot now be known whether it was 'shamming dead'. He lived to kill five lions in seven minutes when serving in East Africa during the 1914-18 War and gave me a photograph showing all the five in the picture.

BANGALORE. R. W. BURTON.
6th January, 1947. *Lieut.-Col. I.A. (Retd.)*.

9—SPOT-LIGHT SHOOTING

In Australia record prices for all fur skins for the American market coupled with the need for reducing the number of kangaroos in some areas, where they eat the young wheat, has given rise to shooting with rifles at night with a spotlight. Rabbits are shot with ·22 rifles, the light being usually a motorcycle headlight connected to a battery carried in a haversack. Rabbits take little notice of the spotlight and it is easy to get a shot. Much the same applies to kangaroos and foxes, which are usually shot with heavier rifles. In the young wheat, shooters sometimes drive about in utility trucks, and when a kangaroo is spotted, he is chased or cut off in his attempt to get to the place where he gets through the fence—usually netting with a barbed wire on top. If it is clear moonlight, kangaroos travel very fast and take the fences in their stride, but in darkness they go much slower and stop at the fence, when they are usually shot. They can also be got by moving through the grass land or open forest at night whether on foot or from a truck. All animals are shown up by the reflection of light from their eyes. For shooting from a truck you require a driver, highly skilled with good night sight, a spotlight operator and the man with the rifle. All the party should preferably be insured against accidents, whether fatal or otherwise. Without a truck each shooter carries his own spotlight and can work single handed. When it was noted how little concern rabbits showed for the spotlight, a fox terrier was induced to join in the hunt, but he never managed to catch a rabbit because, the moment he saw one in the spotlight he charged it as fast as he could and the rabbit, presumably hearing him coming, at once put on full speed and got away. This indicates how acute the rabbit's hearing is for ground noises. His alarm of a couple of thumps with his hind legs is well known. By itself rabbit shooting would produce fewer skins than trapping (only the skins are wanted, the carcases are thrown away), but foxes and kangaroos are also shot at the same time so that when the fur skin market was at its best a lucky shooter might earn several pounds in two or three hours' night shooting. A good kangaroo skin brought anything up to £1-10-0 and fox skins rather more. Rabbit skins were worth as much as 3 shillings each.

C/O. MESSRS. GRINDLAY & CO. LTD., G. DE LA P. BERESFORD.
BOMBAY. *Major-General.*
12th November, 1946.

10.—ON THE NESTING OF THE RED-BROWED FINCH [*CALLACANTHIS BURTONI* (GOULD)]

This is a note of my personal observations near Gulmarg, Kashmir, 25th June—17th July, 1946. I was loath to give up more time to observing this nest, or I might have been able to record more points of interest, but when one's leave is not long and one wants to cover a lot of ground, and see as many different birds as possible one cannot afford to repair day after day for weeks on end to one place to watch one nest.

This finch is not rare in the fir and deodar forests between 9,000 feet and the highest limits of these trees, around Gulmarg. We saw a pair or an odd one of these birds on all our day-long rambles in these forests in most directions from Gulmarg.

Although I only found one nest, I had my suspicions about the existence of two others at least, and I am sure that the presence of these birds in pairs here and there throughout this area meant they were nesting. I saw no family parties of fully fledged young and parents.

These finches are very confiding and allow of a close approach when feeding on the ground, which they do frequently.

On 25th June, at about 9,500 feet I saw a pair of these birds pulling small dry twigs and lichen from the branches of a very large fir and taking the materials to near the top of a smaller tree about 30 yards away. Both birds carried the materials, but owing to their swift movements and the height of the nest I could not be positive if they both built, though this appeared to me to be so. The birds never flew direct to the nest but always alighted some way below it and worked their way up to it.

The nest appeared to have been begun some days previously, and as the last day of construction appeared to be 5th July, this nest must have taken about 14 days to construct. This is borne out by its comparatively massive nature.

On the 8th July the cock bird was seen to feed the sitting hen by regurgitation.

In view of the risk from storms and jungle crows the nest and eggs were procured on 10th July. There were two eggs, both showing slight signs of incubation when blown. They were of a clear greenish blue colour of medium depth, with spots and specks, the former blackish-brown with a brownish nimbus and the latter almost jet black. One egg has only one small spot and a couple of specks while the other is quite well marked at the broad end with a larger spot and a patch about 3 mm. square of closely set specks. One egg is more stubby in shape than the other which is elongated and pointed at one end. The colour of both eggs has faded a bit already. The shell is smooth with a very slight tendency to gloss.

The nest was estimated by means of graticuled field glasses to be considerably over 70 feet up, and about 12 feet from the top of the tree, which was thinly foliaged compared to many of the giants around it. The nest was built about four feet out from the trunk of the tree on a fairly stiff branch, screened from above by the next higher branch which bent down over it fairly closely.

The forest here was semi-open, well watered with small torrents and interspersed with many small grassy *margs*.

The nest was in a tree about 100 yds. from one such *marg* inhabited by *gujars*, with many jungle crows always around, so much so that I little thought I would get the eggs before the crows found the nest and destroyed it.

The nest was a massive, shallow cup. Outside width 5 inches, outside depth $2\frac{3}{4}$ inches. Inside width of cup $2\frac{1}{2}$ inches, inside depth of cup $1\frac{1}{3}$ inches. The outer nest consisted of a mass of wiry lichen, pale greenish white in colour such as is found on most of the firs and deodars in these forests, held together by about a dozen stoutish dry twigs each about 6 inches long. The inner nest was a shallow cup of fine dry herb stalks and rootlets with a thick lining of hair, brown, white and black and seven small feathers. There was a little woolly material between the lichen and the inner cup. The hair was goat or cattle hair with one combing of long black human hair.

C/o. Grindlay & Co.
New Delhi.
14th September, 1946.

H. P. E. WATERS.
Major

11.—THE STATUS OF THE PIED-CRESTED CUCKOO AND GREAT INDIAN BUSTARD IN JASDAN STATE.

It was with great interest that I read in your *Journal* (Volume 46, No. 1, p. 187) the observations of Mr. V. M. Vasu on 'Some common birds of Kathiawar—absent or rare in Cutch'.

Mr. V. M. Vasu says the Pied-crested Cuckoo is unknown in Kathiawar except in some well shaded areas near Bhavnagar and probably Junagadh. I do not know about the rest of Kathiawar but they are quite common in our State.

The Great Indian Bustard is more or less vanishing from Kathiawar. My father has very wisely prohibited their shooting in out State and the result is that, perhaps ours is the only State in Kathiawar where they are safe. About a month ago Sir Cyril Hancock, our Resident came and stayed with us, and as he had not seen the Great Indian Bustard for some years I took him out and showed him some birds and a nest and eggs. I am sorry to say the eggs of this particular nest never hatched. The Great Indian Bustard needs protection. Indiscriminate slaughter if continued would make this beautiful bird extinct.

The Palace,
Jasdan.
25th October, 1946.

SHREE YUVRAJ OF JASDAN.

12.—THE KOEL [*EUDYNAMIS SCOLOPACEUS* (LINN.)] AS AN EGG-STEALER.

I remember this incident of a koel stealing the eggs very clearly. It must have been during the nesting season of 1944, though I do not remember the month. One evening I was bird-watching in the Horticultural Gardens, Lodi Road, Delhi (near Safdar Jang's Tomb). I was standing under an old, gnarled tree watching a dove on one of the top branches, when I noticed a movement lower down the tree. Closer inspection revealed a hen koel hopping deliberately from branch to branch till she reached a main limb of the tree, along which she then proceeded to creep. Her movements were absolutely silent, definitely furtive and appeared purposeful. On reaching the trunk she disappeared from my view, and I moved quietly round the tree, to see her tail emerging from a hole formed by a hollow branch which had been broken off short near the trunk. In a very short time she backed out of the hole, and I saw that she held in her beak a pale blue egg, about the size of a thrush's, but without the black spots (she was only some 6-8 feet above me). She hopped on to an adjoining branch and made several very clumsy attempts to swallow the egg, jerking her head back as far as it would go. In the end it broke, and I could clearly see the yolk running down her breast feathers. She swallowed all she could and then, after a very short pause, moved back to the nest hole and disappeared down it. Only a few inches of her tail showed. She soon emerged bearing a second egg, and this time flew rather awkwardly to another tree a few yards off. I watched her through glasses going through the same attempts at swallowing, but this time she dropped the egg. Instead of going after it she flew off and I recovered it. It was broken and I shall never know whether it broke on falling or whether I trod on it while searching in the grass. During the whole of this performance there was no sign of the parent birds.

BRADBOURN,
COLD HARBOUR LANE, A. E. BAGWELL PUREFOY.
MARLBOROUGH, WHILTS.
7th October, 1946.

13.—BREEDING OF THE BLUE-CHEEKED BEE-EATER (*MEROPS SUPERCILIOSUS PERSICUS* PALLAS) IN BHAVNAGAR STATE

The Blue-cheeked Bee-eater is a regular monsoon breeder in Bhavnagar. They are seen to arrive on the coast in May and start excavating their nest holes in June. Young are usually seen in the latter part of July and August. Some years only few pairs are seen nesting, at others small colonies of a dozen pairs or more. In August and September large congregations of these bee-eaters are observed on lakes, the seaside and fields, and they appear to remain throughout the winter months. They are great travellers, new birds arriving, and those that have remained for some time departing. The migration appears to be North-South and East-West during August-September. During the Spring they disappear only to be seen, when a number of pairs return to breed in the same areas as the preceding season.

DIL BAHAR,
BHAVANAGAR.
5th October, 1946.

K. S. DHARMAKUMARSINHJI.

14.—BREEDING OF PALM SWIFT [*TACHORNIS BATASIENSIS PALMARUM* (GRAY)] AND COOT (*FULICA ATRA ATRA* LINN.) IN BHAVNAGAR.

Since 1944, with the enlargement of the lake, which is now a large stretch of perennial water of approximately 3 sq. miles, there have been two distinct changes in the area below the lake. (1) The subsoil water has risen more than double to what it was formerly. (2) A humid basin has formed with the increase of vegetation. These factors, and an early rainfall, much above the average, have, I believe, induced two species of birds to breed in Bhavnagar. This is the Palm Swift (*Tachornis batasiensis palmarum*) and the Coot (*Fulica atra atra*).

The Palm Swift, I have seen breeding on the Bhavnagar State sea coast at various places where the temperature reached 102 F. maxima in the shade, but it was not common even there. But I had never seen it in Bhavnagar until recently, and having found number of nests during May and June, I feel it is well established with the suitable conditions now prevailing.

As regards the Coot, we had always believed it to be a migratory species in Kathiawar, and I think this is quite true except for the several pairs found breeding this year. Last year I watched a solitary coot remain in a small pool throughout the Spring and Summer months, and I even suspected there was a pair breeding. It is extraordinary that a coot, probably the same bird, remained in the same pool this year as in the preceding. Coots are generally seen leaving in April and arriving in about September—October or even later. This year in August my assistant Mr. P. K. Desai, who is a very keen observer of bird life, mentioned that he had seen a coot's nest, so that I went and confirmed his findings. The solitary nest was situated in the middle of an open pond with few reeds and was quite conspicuous from a road overlooking the pond. Here there are a number of interconnecting ponds approximately 100×60 yards, and all are full by the end of a good monsoon. This year in particular we experienced incessant rain for over a month and these pools were full to the brim by the middle of July which is quite unusual. On further investigation in these adjoining ponds we found four more nests with eggs of the coot and some still building their nests of reeds. It was exciting and strange to see coot breeding at a time when it was formerly considered to be absent.

DIL BAHAR,
BHAVANAGAR.
5th October, 1946.

K. S. DHARMAKUMARSINHJI.

15.—A SWIMMING PEREGRINE

During a visit to Gunong Pulai Reservoir in South Johore recently (October 23rd, 1946), a Peregrine (*F. peregrinus calidus*) was seen to alight at the edge of the reservoir at a spot where a shelving embankment of stone slopes into the lake. The peregrine stepped quickly into water which reached up to its belly and proceeded to have a very thorough bath. Upon our approaching closer to have a better look, the bird was disturbed by our dogs and, after scrambling ashore, took to wing away from land in the direction of the water. It failed to gain height due to the wetness of its feathers and flopped into the water again after it had flown only some 8 or 10 feet. We then had the astonishing view of a peregrine swimming rapidly to land with vigorous, forceful strokes of its wings. Immediately it reached shore the bird took to the air once more and this time, with some difficulty, gained height and eventually flew up into the topmost branch of a dead tree where it spread its wings to dry in the sun.

SINGAPORE.
19th November, 1946.

W. T. LOKE.

16.—PAINTED SANDGROUSE AND OTHER GAME BIRDS IN MYSORE

As I wrote last season reporting the shooting of eight Painted Sandgrouse early in September and suggesting they had come in to that locality due to the failure of the S.W. monsoon, I now write to report that covering the same ground we found none this season, the monsoon has been in excess this season.

When writing last season I cannot recall if I made it clear that it was known these birds frequented that locality at other times of the year, the point was we had not found them on that ground in the previous three years early in September.

I consoled myself during monsoon reading through again Mr. Sálim Ali's *Birds of Mysore*, Vol. XLIV, No. 2, and made the following notes which may be of interest.

Woodcock (*Scolopax rusticola*). These are evidently more common in the planting district of Kadur, mainly the heavy jungle and Ghaut section.

They frequent the cardamom ravines in certain estates and the streams and small rivers in dense jungle. The difficulty is to locate them, and when found to get a shot, hence few make a business of going after them. I have known them as low as 2/500 ft. elevation.

Mr. R. G. Foster, Balur Estate (a favoured locality), who has not always kept records, writes as follows: 'My records show that in the past few years there have been shot 34 birds, that only once has one been killed in December, and none later than March.' He adds weight is usually just under 12 oz. and he is of the opinion they come in with the full moon in December and leave with the full moon of March.

Mr. F. R. P. Cannon shot five in Mertikhan Estate during season 1944-45. I have only shot 9 in 32 years but have not lived in a favoured locality. The earliest record shows 24th December, latest 14th March.

Wood Snipe (*Capella nemoricola*). Only one is noted by Mr. Sálim Ali as recorded after 1883! You kindly identified one for me *vide* your letter dated 31-1-33.

I think probably a few more come into the swamps in these heavy jungles than further east (or even Munzerbad, noted by Sálim Ali)? I have seven recorded, but unfortunately I went mad on fishing at one time and kept no shooting records for 12 years! I only know ONE swamp where I have repeatedly seen them, grass 1 to 1½ ft. high.

Fantail Snipe (*Capella gallinago*) and Pintail Snipe (*Capella stenura*). I do not think the former come into the swamps in these heavy jungle tracts, only upto the outskirts.

My earliest Pintail shot is 3 on August 29th which I informed you of on 30-8-26. The previous year I shot 4 on 20th September and noted 'swamp well stocked', followed by 8 more on 27th September. However, I do not think many come into this part before early October. Two years ago we saw four on 22nd August but this was further east between Chickmagalore and Hassan, and may have been either fan or pintail as none were shot.

I have one recorded shot as late as May 11th but this may have been a pricked bird? Other late dates are 3 on 3rd May, 4 on 27th April, but few remain as late.

Painted Snipe (*Rostratula benghalensis*). I have seen these in this part, but only twice and that in a favoured swamp, surrounded by a maidan as against usual jungle, locality near Balehonnur village. It is where I found early and late pintail snipe.

Jack Snipe (*Lymnocryptes minima*). Have never met these here, and very few further East.

Nukta (*Sarkidionis melanotus*). A friend says he thinks these are more common east of Kadur than as reported round Mysore City?

Cotton Teal (*Nettapus coromandelianus*). These have decreased in recent years where we shoot 30-40 miles from here, and others have reported this to you from other parts of India. What is the reason?

Common Whistling Teal (*Dendrocygna javanica*). Strange to say these come in to breed during the S.W. monsoon on ponds on the Balehonnur maidan (mentioned under painted snipe). The Badra river is not far off. Never seen there at any other time of year, plenty of course 20-30 miles from here.

Grey Jungle Fowl (*Gallus sonnerati*). I have not noted chicks earlier than Feb./March, although a friend says he has. I should say it is rare due to the heavy S.W. monsoon followed immediately by the N.E. monsoon?

I think some chicks died this last heavy monsoon?

Southern Grey Partridge (*Francolinus pondicerianus*). Noted as 'not common', presumably in comparison with other parts of India? It might be added due to netters! They are often on sale in the Russell Market, Bangalore, during the close season, and the Moore Market also quotes them in that season! The netters will clear a locality in no time.

To show how common or uncommon they are—two guns H Q Kadur bagged 23 in 3½ days shooting early in September, and we lost quite a lot of weight doing it! One bird contained an egg, not experienced in the previous four seasons. I believe this late breeding is not unknown, I have seen chick March 22nd.

ADDENDA.

Grey Jungle Fowl. I mentioned I had not noticed chicks earlier than Feb./March so now report having found a fortnight ago egg shells which presumably could not be a pre-monsoon brood as over 100 inches has fallen since June 1st.

Red Spur Fowl (*Galloperdix spadicea*). I saw a brood of three newly hatched chicks on 24th November. I have not noticed these either breeding at this season before.

KURADY KHAN ESTATE,
SANGAMESWARPET P.O.,
KADUR DISTRICT, G. V. R. FREND.
MYSORE.
3rd October 1946.

17.—OCCURRENCE OF THE MALAY BITTERN (*GORSAKIUS M. MELANOLOPHUS*) IN MYSORE.

I enclose the head and wing of a bird I shot in bamboo jungle below here for identification. It appears to be of the bittern family? Sálim Ali (Vol. XLIV, No. 2) only mentions one bittern—*Botaurus stellaris.*

KURADY KHAN ESTATE,
SANGAMESWARPET P.O.,
KADUR DISTRICT (MYSORE STATE). G. V. R. FREND.
17th September 1946.

[Mr. Sálim Ali has examined the specimen and identified it as *Gorsakius melanolophus melanolophus* the Malay Bittern.

According to the *Fauna* the distribution of this species is Ceylon, the Malabar Coast to the Southern Bombay Presidency, Assam, Manipur, Burma South through the Malay States to Sumatra, Java, Borneo and Formosa.

In the Report on the Ornithological Survey of Travancore and Cochin, the following has been recorded :—

'Not met with by the Survey.'

Ferguson mentions (*J.,B.N.H.S.*, XVI, 17) that F. W. Bourdillon obtained a specimen of the Malay Bittern on the hills at about 2,500 ft. elevation in 1878, and that subsequently he received 2 live specimens. Stewart seems to have found it common in Travancore (*Fauna* VI, 362).

It has not been recorded from actually within the Cochin State, but it must doubtless occur there. Kinloch (*J.,B.N.H.S.*, XXIX, 294) obtained a specimen and found it common in the Nelliampathy valley. He also saw this bittern at the foot of the Palghat Hills.

Breeding: *Nidification* (iv, p. 479) records that Stewart took many nests of the Malay Bittern in Travancore from the end of May to early July.—EDS.]

18.—THE KENTISH PLOVER [*LEUCOPOLIUS ALEXANDRINUS* (LINN.)] BREEDING IN KATHIAWAR.

This is the first record of the Kentish Plover breeding in Kathiawar. And it is most interesting to note that the nearest place of its breeding being in Sind provided, the species is *Leucopolius alexandrinus alexandrinus*. However, there is some mention of its breeding in the Rann of Kutch, but this has not yet been fully confirmed. Mr. Sálim Ali does not include it in his 'Birds of Kutch', although it may occur there in small numbers. But if the species found in Kathiawar is the Indian Kentish Plover (*Leucopolius alexandrinus seebohmi*), then the nearest record of its breeding is in Ceylon, and it is also said to breed on the shores of the Red Sea and Coast of Somaliland. I am afraid it has not been possible for me to distinguish which sub-species the Kathiawar Kentish Plover belongs to. Shooting the birds off their nests seems to be the only way to confirm it. I hope more evidence of this plover breeding in Kathiawar was available so that there is no fear of destroying the few pairs that breed with us. Now before I venture to give an actual account of the Kentish Plover breeding I should like to mention a clue that helped me discover the actual pair of birds and their eggs.

I was staying at Victor, Bhavnagar State, during the Summer, and on returning from a brief visit which I had made I was informed that there had been a very high tide on the 2nd June 1946—the highest tide recorded for many years together. This unusual phenomena caused the mud flats to be entirely submerged to a level never before reached. This resulted in my picking up two eggs.

Actually, it happened on the morning of the 7th June. Walking along the high tide line, my eyes rested on two eggs lying on the ground amongst the debris brought up by the sea. On picking them up, it struck me that they did not belong to the resident species of Plovers that I knew were breeding in Kathiawar. One of the eggs was slightly broken at the top, the other entire. This evidence was enough to commence further observations. On taking the eggs to the bungalow I tried blowing them, but found that they contained well developed embryos. This also ascertained that the eggs had been incubated regularly and were not any stray eggs deposited here and there, as some migratory birds do.

It was not until another twelve days that I discovered the Kentish Plover and its eggs, and I may say that this was almost by coincidence, for in spite of the fact that some shore birds such as curlew, shanks and small plovers were to be seen flying on the mud flats and along the creek, none indicated that they were nesting. However on the evening of the 17th June I nearly trampled on the nest when my shikari spotted the eggs. The eggs were warm which revealed that they were being incubated. As it was past sunset I was unable to clearly distinguish the bird which came to the nest immediately. It was a miniature plover.

The next morning going to the nest I found the bird sitting on the nest and approached it as close as 20 yards before it left the nest. The nest was situated in a shallow sandy river bed about 3 miles from the creek. The actual site of the nest was on a sandy holm, few feet away from a solitary green tuft of grass. The nest was made up of conspicuous tiny white pebbles along with minute shells. The three eggs which made up the clutch were embedded in the sand with their points inwards and downwards and were typical plovers eggs. Within 5 minutes both parents appeared on the scene and began feigning wounded by spreading out their wings and tail alternately. Coming in front and moving away in a crouching manner attempting to lead me away from the nest; they also emitted a call like *wheet wheet* at times. They were very shy of the camera and not having the necessary bird photography equipment I failed to secure a good photograph. However, they did not move further than 15 to 20 yards away from me; hence I made a very satisfactory study of the pair for about four hours with my binoculars and then took the eggs for my collection. The egg measurements are as follows:—

1 egg found 30·2 × 22·5 mm.
Broken egg not measured.

Clutch of eggs	1	32·5 × 22·5 mm.
	2	30·7 × 22·7 mm.
	3	31·0 × 22·5 mm.

DIL BAHAR,
BHAVANAGAR.
5th October, 1946.

K. S. DHARMAKUMARSINHJI.

19.—WOODCOCK (*SCOLOPAX RUSTICOLA* LINN.) FEEDING WITH POULTRY.

While wandering up and down this mill stream my shikari drew my attention to a 'large snipe'! I looked round and there I saw a woodcock sharing the same food—chaff and grain from the nearby corn fields—with a 'Desi' cock and hen. I flushed all the birds and the domestic chickens flew up into the yard of a small hut nearby while the woodcock flew on another few yards and settled. He did not seem to be at all weak in flight and was in excellent condition—I observed him from only two or three yards. I flushed him twice more and lost him in a corn field. Two days later, exactly the same experience happened to me at the very same spot. Can you give me an explanation please. Don't forget the bird was strong on the wing, and seemed very loth to leave his 'friends'. The height of the spot is about 6000′ or 6500′.

REGIMENTAL CENTRE,
HAPPY VALLEY,
SHILLONG, ASSAM.
27th November 1946.

E. G. DEEKS.

20.—NOTE ON THE MIGRATIONS OF SWINHOE'S SNIPE [*CAPELLA MEGALA* (SWINHOE)] AND FANTAIL SNIPE [*C. GALLINAGO* (LINN.)] IN MALAYSIA.

There are three possible varieties of snipe to be found in the Malay Peninsula, *Capella stenura*, *C. gallinago* and *C. megala*, respectively the pintail, fantail and Swinhoe's (or Chinese) snipe. The first and second are so identical in appearance that only a careful scrutiny of the plumage will reveal the difference. The last (Swinhoe's) is a trifle larger and has a longer bill, otherwise it is easily passed over in a bag containing other snipe. The only certain method of rapid identification of all three species is by an examination of the tail feathers. In young birds of the year these may not be well developed enough to show the characteristic patterns, but the number of feathers at once reveals the difference between them. The fantail has 10 broad feathers, Swinhoe's snipe usually 20 of which the middle six are broad and the rest 'semi-pin' type, and the pintail on an average 26, of which the middle ten are broad and the rest true pin feathers.

The overwhelming majority of snipe shot in the Malay Peninsula are pintails. The occurrence of the other two is sporadic. Robinson and Chasen in *Birds of the Malay Peninsula* (Vol. III) simply say of the fantail that 'it visits in very much smaller numbers than the pintail and many of the latter can be killed for one of the former'. Of Swinhoe's snipe there is the statement that it is 'probably not at all rare in the Malay Peninsula'. As long ago as 1922 I was interested in the last species and kept a careful record of the number of snipe shot and the occurrence of fantails and Swinhoe's in the bag. Every bird was subjected to as careful an examination was possible. The results were as follows. The first examination was made on 6-2-22, and with an interval of two seasons, when I hardly shot any snipe, it was maintained up to and including 1936. The grounds covered were both on the east and west of the main range—the backbone of the peninsula. No specially big bags were made in any one season—the biggest being 206 in 1928-9 season. A total of 1,360 birds were scrutinised giving an analysis of pintail 1,350, fantail 5 and Swinhoe's 5. The bags were made at no particular dates through the season and no apparent deduction can be made from this. The rare species were shot almost equally on both sides of the peninsula. It is clear that, unless my totals were weighted to a most unlucky degree, and allowing for mistakes, both the fantail and Swinhoe's snipe are rarities in the Malay Peninsula.

Records from two other countries to the west and east of the Peninsula, have lately come to my notice. Mr. Banks in the annual reports on the Sarawak museum records the occurrence of these species in Sarawak over a period of four years—1927, 1928, 1929, and 1931. Unfortunately no reference is made to the number of pintail shot, presumably considerable as it is the common snipe of the country, but the other two species are evidently worth recording as rarities. The figures are—1927. 3 fantail, 2 Swinhoe. 1928. 2 fantail. 1929. 1 fantail, 1 Swinhoe. 1931. 2 fantail. 2 Swinhoe.

In a note on the distribution of Swinhoe's snipe in Bengal in *Journ., Bomb. Nat. Hist. Soc.*, Vol. 42, p. 442, by Mr. R. J. Clough (1940), there is the remarkable record—

'The first Swinhoe's snipe to turn up in a total of over 16600 in bags made since 1926-7 all within a radius of 40 miles from Calcutta' (all examined for varieties). The fantail there is the common visitor.

In the Phillipines *megala* is said to be 'very abundant at certain seasons in the ricefields'. (Hachisuka).

The bird's migration is evidently in an easterly direction towards the Moluccas rather than south and west. It is noticeable that the general line apparently follows the northern edge of the Sunda shelf, and at right angles to the prevailing wind—the N.E. (China) monsoon—which blows strongly during that season.

SEEND, WILTSHIRE. J. E. KEMPE.
November 1945.

21.—OCCURRENCE OF THE WHOOPER SWAN [*CYGNUS CYGNUS* (LINN.)] AND GREATER EUROPEAN BUSTARD (*OTIS TARDA* LINN.) IN THE PUNJAB.

His Excellency the Governor has asked me to write and tell you about the occurrence of several unusual birds in the Peshawar District during the last month.

On the 29th December 1946 a single lone Whooper swan was shot at Dera Mohmin on the Kabul River in the Peshawar District. This is the third occasion in the last thirty years when this bird has been met with in this area. One was shot at the same spot by Mr. Domely I.P. in December 1910, and another by Brigadier Sir Hissamuddin Khan from a flock of four in 1927.

A Greater European Bustard was shot on the Cajuri Plain on the 5th January 1947. It appeared to be a young female in rather poor condition, and its weight when cleaned was about 5½ lbs.

We understand that one European Greater Bustard was brought to Sir George Cunningham during his period as Governor, and another from the Charsadda Teshil was brought to Sir Norman Bolton in 1927.

It is believed that an unusually cold spell in Afghanistan has forced these rare visitors down from Central Asia to the Peshawar District, as has occasionally happened in previous severe winters.

PESHAWAR,
6th January 1947.

A. D. H. BIVAR,
Captain, A.D.C. to H. E. the Governor.

22.—RECOVERIES OF 'RINGED' DUCK.

Pintail (*Dafila acuta*).

A pintail (Ring No. 83520-D) ringed by the Bird Banding Bureau, Moscow at the Astrakhan State Reserve on July 30th 1944, was shot at Wankaner, Kathiawar State (Lat. 20°, Long. 71°) on the 24th January 1946. The recovery was reported by Maharaj Kumar Chandrabhanusinhji and the date and place of ringing by the Moscow Bureau.

Mallard (*Anas platyrhyncha*).

A Mallard in process of moulting, (Ring No. 87676-D) ringed at the Astrakhan State Reserve near Astrakhan Delta of the Volga River on the 14th January 1945 was shot at the Sakrand Lake, Nawabshah, Sind, (Lat. 26°, Long. 69°). Recovery reported by Mr. Hardit Singh, Inspector of Agriculture, Nawabshah, Sind, the date and place of ringing by the Moscow Bureau.

EDITORS.

23.—DAWN-CHORUS IN A SOUTH INDIA FOREST.

The valley faces east, and looks forty miles away across the plain to the sea and to the sun-rise.

The Malabar Whistling Thrush is usually the first awake, and at 6.30 a.m. today (January 29th, 1946) his whistle came from the river-bed. The impatient rattle of the Black-naped Flycatcher was next, and soon a Small Green Barbet was calling. Several Yellow-browed Bulbuls woke up and talked sleepily to one another. From the far slopes came a Quaker-Babbler's five-note call, followed at once by the Spotted Babbler's 'wandering' song, running aimlessly down the scale. It was now 6.36, and a Grey Jungle Cock crowed on the northern slope. A Small Sunbird sang its higher pitched song over and over, how it managed to take breath and to sing so fast I do not know. A Scimitar Babbler with its liquid, bubbling notes joined in. Then a Fairy Blue Bird began. By the time it was 6.39 and the air was full of sound; the Spotted Babblers (with their four-note call and their longer song), Barbets and Yellow-browed Bulbuls being the chief contributors. At 6.41

the Ruby-throated Bulbul's monotonous four-note call was heard from several places, one bird answering another. The Emerald Dove's mournful coo came in as a backing sound to the chorus. Grey Drongos began shouting to each other at 6.44, and, just after, the Malabar Loriquet's high-pitched squeaky three-note cry showed that these last two species had begun their morning rivalry over the fresh honey in the flowers of the *Acrocarpus fraxinifolius* tree behind the house. The Pitta must have overslept, for his early 'Good morning' was absent today. And the Bluechat's sweet whistle, which I heard yesterday did not join in. For ten minutes or so the chorus continued and then gradually died away, as they all settled down to the more prosaic job of looking for breakfast. Only the plebeian Grey Drongo continued to shout during meals.

NARAIKKADU,
NEAR DOHNAVUR, S. INDIA. C. G. WEBB-PEPLOE.
29th January, 1946.

24.—MANGO-FRUIT—ON THE MENU OF THE COMMON PYTHON (*PYTHON MOLURUS*).

This is an account of a python swallowing mangoes!! The incident occurred in a tea plantation in the neighbourhood of Siliguri in the district of Darjeeling.

In the month of June (1946), just before dusk, a few tea-garden workers returning after a day's labour detected a python beneath a large mango tree in the tea-garden compound. The python was swallowing a mango which had fallen from the tree. The manager of the garden, who arrived at the spot saw the snake devouring the mango. The bulging of the neck region could be seen from a distance. Later the snake was killed.

During the skinning of the snake, the oesophagus was also cut open, and four mangoes were recovered from it. The pericarp of these mangoes bore the marks of the teeth of the reptile, the fruits were otherwise intact. The length of the snake was 13 feet.

After a detailed examination of the mangoes—found within the oesophagus of the snake, and also those obtained fresh from the tree, it was noted that they were infested with insect larvae. Each mango contained two or three larvae.

A diet of fruit is surely unusual for a snake. The four mangoes inside the alimentary tract suggests that they were not accidentally swallowed.

The author's acknowledgments are due to Mr. T. P. Banerjee, manager of the tea garden, for the observations here recorded.

ZOOLOGICAL LABORATORY,
UNIVERSITY OF CALCUTTA, SIVATOSH MOOKERJEE.
35, BALLYGUNJ CIRCULAR ROAD,
9th November 1946.

25.—SEX OF MAHSEER AND BOKAR CAUGHT IN N.E. INDIA.

Whilst fishing the Teesta with Mr. Langdale-Smith in 1943 this gentleman asked me if I had ever noticed that practically all the mahseer or bokar (katli) one caught are females.

Until then I had not considered the point but afterwards, whenever it has been possible, I have opened out a catch at the end of a day's fishing and confirmed that this is indeed correct.

On a ten-days expedition in the Ledo Tribal Areas in 1944 with Mr. Walker, the Political Officer, we made a careful check-up on practically all fish taken and found the percentage of hen fish to be approximately 98%.

The time of the year was November but I have found the same thing in February and March before the rains come to put a stop to any fishing.

It would appear from this either that the cock fish exist only in a proportion of 2% or that they do not take a bait, be it spoon, plug or fly.

Mr. Langdale-Smith has indeed started up an interesting field of investigation and it would be of extreme interest if such an acknowledged expert as Dr. Hora would throw some light on this matter in the pages of your *Journal.*

There appears to be very little accurate knowledge as to breeding periods of mahseer and bokar but it would appear that there is no clear-cut month, or months, and breeding goes on throughout the whole year. It is probable, however, that Mr. Langdale-Smith is about the only man in India who has had both these species of *Barbus* under observation throughout the whole of the year. On his Estate, Rungli Rungliot, in the Darjeeling area, he has several semi-natural pools fed by steeply-falling streams from the hillsides above and stocked with both.

Some of the mahseer must be in the region of twenty-five pounds and have become extremely tame as they are fed regularly. On one occasion, whilst stopping at Rungli Rungliot I had the extraordinary experience of having one of the biggest take a large bunch of worms from the palm of my hand as I lay flat on the bank of the pool with arm at full length under water, the fish having been enticed closer and closer to the side by worms thrown in for him (or her).

As far as I can remember the mahseer are kept separate from the bokar or else there are no large bokar with the mahseer.

Any small bokar would probably be eaten by the mahseer.

The bokar appeared to have bred in the shallow waters of the upper pools and it would be of great interest if Mr. Langdale-Smith could publish the results of his observations in this connection.

HOOGRIJAN P.O., F. WOOLLEY SMITH.
UPPER ASSAM.
30th September, 1946.

26.—KRAIT'S METHOD OF DEFENCE AGAINST CAT.

I give the following account of a Krait's method of defence against cat and hope you will find it interesting, if not new.

Soon after dark on the 29th ultimo children playing in our garden came hurrying to me and—told me that a cat was playing with a snake in the garden. I rushed to the spot and saw a Common Krait (*Bungarus caeruleus*) tightly coiled up and hiding its head under its coils, while our pet cat was trying to uncoil it. The reptile was feigning death, and so motionless did it lie that I was prone to doubt if it was alive, though its tight coils indicated that it was anything but dead. I touched it with a stick and satisfied myself that it was very much alive. The cat lost almost all interest as the krait lay quiet and did not give her battle. However, I forced the reptile to show its head which excited the feline's interest. The cat evidently wanted to crush her enemy's head, but the latter was extremely careful not to expose its delicate but deadly part of its body. As the contest was proving tedious I forcibly uncoiled the snake and pressed it by its neck with a stick, whereupon the wrigging—mass of its body immediately curled round the—stick. This new development excited the cat's interest and she caught per prey by its tail and gave it a nasty pull. I soon let go the snake—hoping that a real fight might now ensue, but to my great disappointment the krait again went into tight coils hiding its head effectively and so—the cat again lapsed into inactivity. I killed the krait—which measured exactly two feet.

Conceding that the Common Krait is timid by temperament it looks a little strange it did not make the slightest attempt to bite the cat, nor did it resort to hissing. I think the reptile's passive resistance was remarkable, while our pet cat distinguished herself by her 'sporting' spirit in so far as she disdained to strike an opponent who would not retaliate.

80 A, KURLA ROAD, V. M. VASU.
ANDHERI, BOMBAY.
8th October, 1946.

27.—ADDITIONS TO 'THE LIST OF BUTTERFLIES OF THE SIMLA HILLS' PUBLISHED IN VOL. XLI, NO. 4 (SEE ALSO VOL. XLV, NO. 2).

287. **Lethe nicetas,** Hew. ♂ Baghi, 9,000', September.

77. **Maniola lupinus cheena** M. ♂ ♀ Nachar, 7,000'. July. (See note in Vol. XLV, No. 2).

288. **Ypthima inica,** Hew. ♀ Chandigarh, 2,000', 12/11. This butterfly seems to be abundant in parts of the Punjab and may possibly be common at the foot of the hills. On the wing it is very like *Y. asterope* and may easily have been overlooked.

289. **Limenitis trivena hydaspes,** M. ♂ Pangi, 9,500', June. This is a very different butterfly from *L. trivena pallida*, the race that is so common

near Simla. As *ligyes* and *trivena* are races intermediate between *hydaspes* and *pallida* it seems probable that both of these must also appear somewhere in the country between Pangi and Simla.

290. **Everes diporides, Chap.** ♂ Simla, 6,500′, May. ♀ Simla, April.

291. **Thecla ziha, De N.** De Niceville mentions a specimen caught near Simla on May 20th.

292. **Caprona ransonnetti (? taylori, De N.).** Mr. Wood-Robinson informs me that he caught what must be a specimen of this butterfly near kalka early in 1946.

293. **Astychus pythias bambusae,** M. ♂ Subathu, 4,500′.

294. **Pamphila comma indicofusca,** M. ♂ Shipki District in July.

Notes.

21. **Pieris napi.** I possess a ♀ from Nachar which appears to be typical race **montana.** Evans gives the range of **montana** as from Sikkim to S. Shan States. Napi, however, is a very variable species.

226. **Spindasis elima uniformis,** M. Further records ♂ ♂ ♂ Chaba, 3,000′, 10/8; Kalka, 3,000′, 3/10; Simla, 5,000′, 9/8.

285. **Ismene aedipodea aegina, Plotz.** A further record of a ♂ from Chaba, 3,000′, 6/9′ 33. I have a suspicion that our records of *Ismene jaina* fergussoni relate to this species.

JAMNAGAR.
7th November 1946.

M. A. WYNTER-BLYTH,
M.A. (CANTAB).

28.—ADDITIONS TO 'THE BUTTERFLIES OF THE NILGIRIS' PUBLISHED IN VOL. 44, NO. 4 AND VOL. 45, NO. 1.

305. **Pareronia valeria hippia, ♀ form philomela,** F. One specimen from Kallar in the B.N.H.S. collection.

306. **Lycaenesthes emolus emolus,** Fd. Specimen from Kallar in B.N.H.S. collection.

307. **Hasora badra badra,** M. Listed by Yates in his revision of Hampson's list of Nilgiri Butterflies, Vol. XXXVIII, No. 2, of the B.N.H.S. Journal.

Note on Yates' comment (in Vol. 46, No. 1) on my statement that *Euthalia evalina laudibilis*, Swin. '*seems* to be common round Bangalore'. I visited Bangalore for three days in September of 1943 and saw one or two specimens of this butterfly on the wing in the Cantonment: I also saw two specimens recently caught in the Cantonment. I have been in correspondence with Mr. Yates and the appearance of this butterfly in Bangalore seems to be most exceptional.

JAMNAGAR,
7th November 1946.

M. A. WYNTER-BLYTH
M.A. (CANTAB).

29.—NOTE ON THE BUTTERFLY *VALERIA VALERIA HIPPIA* (FABRICIUS) ♀ FORM *PHILOMELA*.

This form mimics *Danais aspasia*, F. which flies with its mimic in Burma but does not appear in India. Nevertheless *philomela* is found in S. India (Kanara and the Nilgiris) and also at Jubbulpore (mihi), Calcutta (Sanders) and in all probability throughout N.E. India.

To quote from Bell, 'The ground colour (of *philomela*) UPH at base in interspace 1a, over the whole of interspace 1, area of cell, and at base of interspace 2, is suffused with bright yellow. On UNH the same areas are dull ochraceous.'

He further states, presumably with reference to N. Kanara, that, "This form does not appear till the end of the rains; in a brood of, say, 15, of which 7 are ♀♀, 1 or 2 may occur with these yellow markings."

Talbot in the *F.B.I.* (Butterflies, Vol. I, 2nd Edition) states "Models and mimics usually will be found to occupy the same faunistic area, and to fly together. . . . As a general rule the mimic is not found beyond the geographical range of the model; but there are some notable exceptions, as, for example, the forms of *Valeria*, which resemble Danaids that do not fly in the same area. This case is explained on the ground that their chief enemy is a migratory species of wagtail (Rosa, 1937)."

Mr. Sálim Ali, with whom I have discussed the matter, says that he knows of no wagtail that migrates from Burma (or Malaya or the E. Indies, where both butterflies occur) to S. India, N.E. India and the Central Provinces. Furthermore he does not like the idea of a wagtail as a selective agent . . . especially in the case of a powerful and fast-flying butterfly such as *Valeria*. A wagtail *might* pick up the odd weakly-flying butterfly settling on grass or low-growing flowers, but never, surely, one of the habits of the species under discussion.

Two other solutions occur to me.

If *Valeria* is a migrant from Burma (or Malaya or the E. Indies) to India the sporadic occurrence of *philomela* is only to be expected. Unfortunately I can find no evidence to show that it is a migrant at all (except that its trivial name, the 'Common Wanderer', leaves a suspicion that such evidence does exist). I have direct evidence that mimics can and do exist in areas far removed from that inhabited by their patterns. *Papilio polytes* ♀ form *romulus* has been recorded by me from Simla while its pattern *Polydorus hector* is not found nearer than Bengal. The *romulus* form is also found in Kathiawar where *Polydorus hector* is absent. *Papilio polytes* is a migrant.

Secondly it does not seem beyond the bounds of possibility that *Danais aspasia* once flew in India with its mimic. Change of climate or other causes may eventually have eliminated the Danaid whilst the hardier and more adjustable *Valeria* survived, the occasional occurrence of the *philomela* form being a relic of the days when it flew together with *D. aspasia.*

It should be noted that we have been unable to obtain the paper by Rosa quoted above.

MANN VILLAS PALACE,
JAMNAGAR.
3rd November 1946.

M. A. WYNTER-BLYTH,
M.A. (CANTAB).

30.—AN ABERRANT FORM OF *NEPTIS HYPLAS ASTOLA.*

(*With a plate*).

The upper figures in the plate show the upper and under sides of a very interesting aberration of *Neptis hylas astola*, M. and the under figures those of the typical form (D.S.F.) The specimen was very kindly identified for me by Brigadier Evans and is now in the British Museum (Natural History). The General says that the special interest of the specimen lies in the suppression of the broad central band on both fore and hind wings and the post discal band on the hind wing. Also in the enlargement of the normally very narrow and rather obscure central band on the hind wing and the enlargement of the submarginal band on the fore wing.

The specimen was caught in March at 2,000′ in the Chota Rungeet valley, north of Darjeeling. The typical *Neptis hylas astola*, M. is very common and specimens may be seen all the year round but the new broods appear in March.

TUKVAR T.E.,
DARJEELING P.O. E. W. MAUDE.
27th August 1946.

31.—THE MALE GENITAL TUBE IN INDIAN *LAMPYRIDAE.*

(*With two diagrams*).

Sharp and Muir in their well-known treatise on the comparative anatomy of the male genital tube in *Coleoptera* (Trans. Ent. Soc. Lon. 1912) have included four species of *Lampyridae* of which *Luciola vespertina* F. alone appears to be from India. The morphology of the male genital tube has not been studied so far in any other Indian Lampyrid. The present paper describes the morphology of the male genital tube in four species of Lampyridae from India.

1. *Lamprophorus tenebrosus* Wlk., from Tambaram and Pampadampara, N. Travancore.
2. *Lamprophorus lutescens* Wlk., from Lushai Hills, Assam.
3. *Luciola gorhami* Rits., from Nagercoil, Trivandrum and other parts of S. Travancore.
4. *Diaphanes* sp. (*D. planus* Gor.?), from Pampadampara.

The following observations were made from micro-dissections and from whole mounts of the genitalia treated in caustic potash. I am deeply thankful to Mr. J. C. M. Gardner, Forest Entomologist, Dehra Dun for his valuable help in the proper identification of species.

Lamprophorus appears to be the most primitive in its outer tube of aedeagophore being composed of unmodified sclerites of the body wall. In both *L. lutescens* Wlk. and *L. tenebrosus* Wlk.,

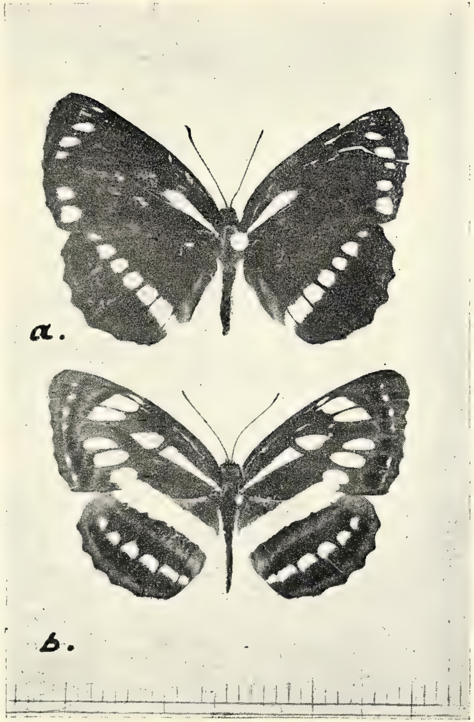


FIG. 1 (Uppersides).

a. Neptis hylas astola: (aberrant form)
b. —ditto— (typical dry season form)

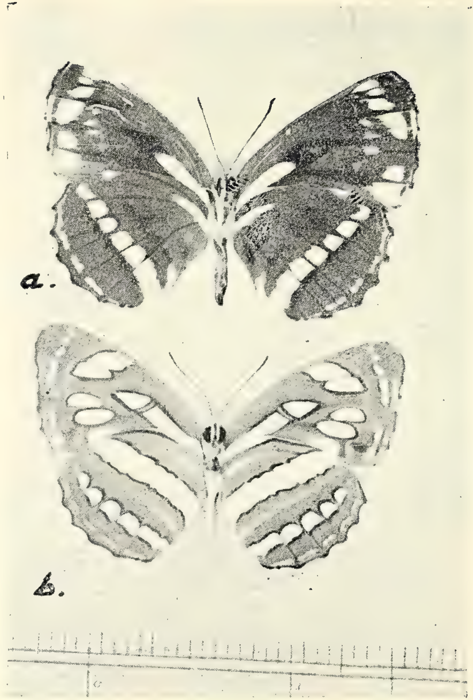


FIG. 2 (Underside)

a. Neptis hylas astola: (aberrant form)
b. —ditto— (typical dry season form)

AN ABERRANT FORM OF *Neptis hyplas astola*

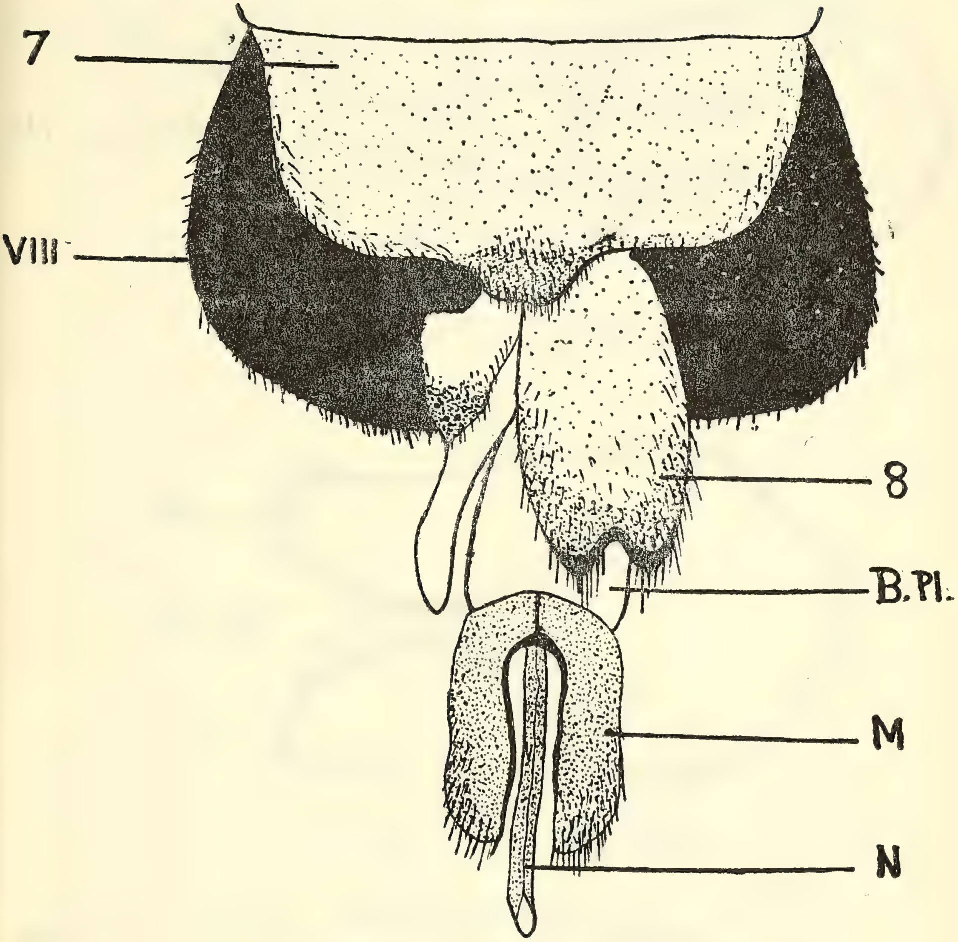


FIG. 1.

Lamprophorus tenebrosus Wlk. Male genitalia *in situ*

7, 8.	7th & 8th Sternal plates.
viii	8th Tergal plate.
B.Pi	Basal Piece.
M	Lateral lobe.
N	Median lobe.

Indian Lampyridae

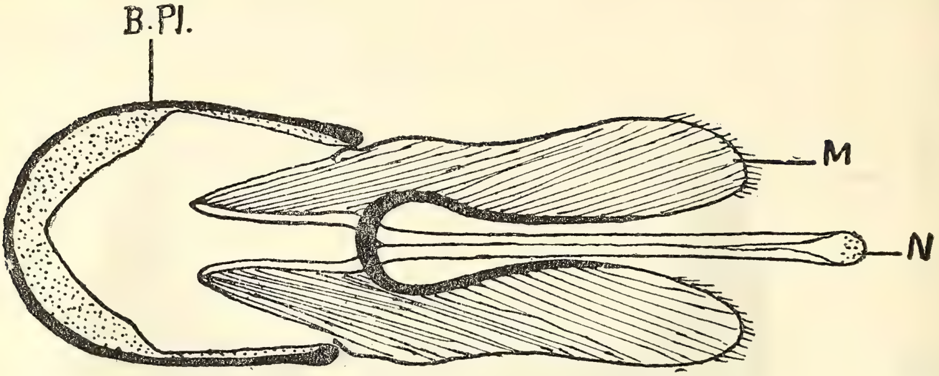


FIG. 2.
Lamprophorus tenebrosus Wlk.
Aedeagophore with basal piece.

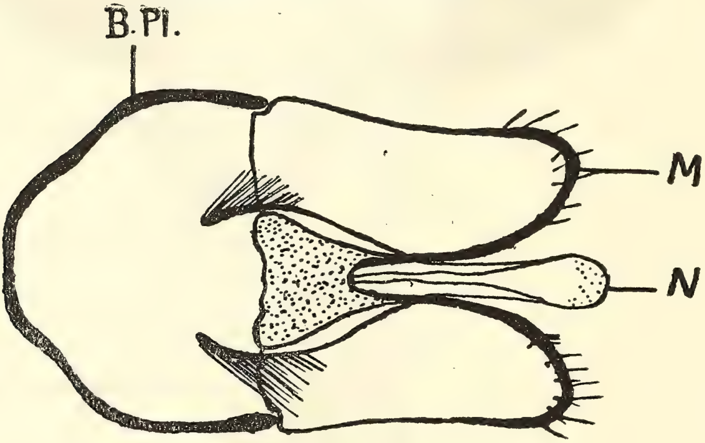


FIG. 3.
Luciola gorhami Rits.
Aedeagophore with basal piece.

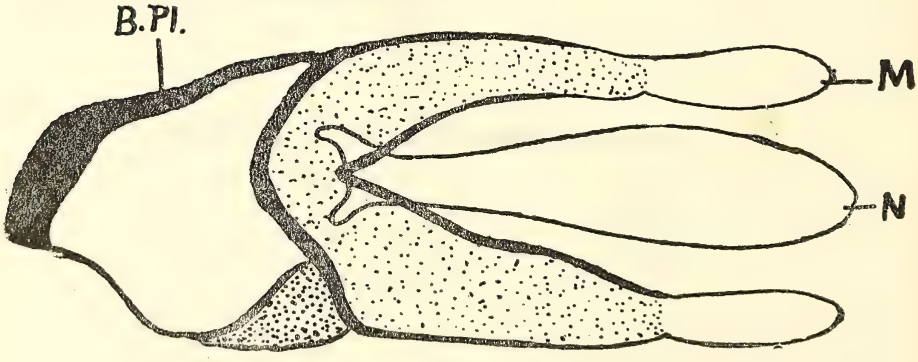


FIG. 4.
Diaphanes sp.
Aedeagophore with basal piece.

Indian Lampyridae

the median lobe projects beyond the lateral lobes (parameres). It is comparatively much longer in *lutescens* than in *tenebrosus*. The median lobe is more or less uniformly narrow in both species. Lateral lobes are undifferentiated, setose and consolidated basally. Basal piece is an arched symmetrical plate which runs from the base of one lateral lobe to the other and also articulates with it near the base.

In *Diaphanes* and *Luciola* the outer tube of the aedeagophore is composed of modified sclerites of the body wall. The aedeagophore is supported by a well developed chitinous branched frame work probably formed of the posterior most sternal elements. The mediam lobe in *Diaphanes* sp. is club-shaped and as long as the lateral, but never projects beyond it. In *Luciola gorhami* Rits. the median lobe is apically bulbous and as long as or slightly longer than the lateral. The lateral lobes are apically slender and membranous in *Diaphanes*. They are undifferentiated and uniform throughout in *Luciola*, although much stouter than the median lobe. The lateral lobes are consolidated basally. The basal piece is irregular and asymmetrical in *Diaphanes*, but in *Luciola* forms a slender and symmetrical arch which articulates with the posterolateral angle of the lateral lobe.

MADRAS CHRISTIAN COLLEGE, J. SAMUEL RAJ, M.A.,
TAMBARAM. *Lecturer in Zoology.*
10*th October* 1946.

32.—'TERMITE FUNGI'.

In volume xxxv, p. 909 of the *Journal*, I published a note under the same title, together with a photograph, and now I have come across a second instance of the kind, but this time the termites are not of the mound-building type, but a timber destroying species. In a corner of the compound lay some rotting branches and strips of bamboo. The termites had attacked this material and covered it with earth in the usual fashion. The earth was overlaid with what appeared to be 'fungus garden' material and out of this a rich crop of Agarics appeared. This species appeared to me to be larger and different from the one that was 'grown' by the mound builders. (I have sent specimens to Prof. S. R. Bose and perhaps some day he may be able to enlighten us on the identity of the species.)

As soon as the presence of the fungus was discovered by the local Maharatas they gathered in the crop—a small basket full—for the 'pot' as this species is eaten. Without questioning the people, they informed me that these fungi *always* appear where the termites are present! This information is interesting, but it may be argued that the damp conditions favoured the development of the fungus without having any connection with the termites. However this arguement alone does not explain the fact as it remains to be explained how the 'fungus garden' debris got there without the aid of the termites. Further investigation of this subject would no doubt be interesting and perhaps prove useful as a step towards fungus cultivation for purposes of food.

10B, Pali Road,
Bandra. C. McCANN.
22nd September 1946.

33.—*RANDIA CORYMBOSA* WIGHT & ARN. (*RUBIACEAE*) A NEW RECORD FOR THE BOMBAY PRESIDENCY.

In April 1945 Dr. M. Suter sent me a specimen of *Randia* which he could not place with certainty. After a careful examination of the material I experienced a similar difficulty. I asked Dr. Suter to send me further material which he very kindly did and, what was more helpful, he sent the specimens in a fresh condition. Pursuing the subject further with the fresh specimens and the literature available I concluded that we were dealing either with a new species or an ill-defined one. I preferred the second alternative, and decided that the plant in question is no other than *Randia Candolleana* W. & A. The descriptions in the available floras did not satisfy me and, so I went back to the original description in Wight and Arnott's Prodromus. All the authorities agree that Wight and Arnott's *R. corymbosa* and *R. Candolleana* are synonymous and I agree with them. However, under the circumstances there arises a question of priority. The two names appear on the same page (p. 399) but *R. corymbosa* appears above *R. Candolleana*, what is more, they are also numbered 1232 and 1233 respectively; further, in Wight's *Catalogue* the names follow the same sequence and are numbered 1279 and 1280 respectively. To be in keeping with the Rules as the name *corymbosa* appears first, followed by *Candolleana* I adopt the name *R. corymbosa* and religate *R. Candolleana* to the list of synonymy.

Wight and Arnott had only a single specimen of their *R. corymbosa* and they had not seen the fruit. The fruit of their *R. Candolleana* they describe in two words "fruit globose". There is barely any difference between the two descriptions except on the amount of pubescens—however, a point worthy of note is the authors' remark, viz., "The limb of the calyx, when the fruit advances towards maturity, appears, from various causes, to be more or less completely broken off." This point I have also observed—no trace of the calyx appear to persist as in the case of some of the other species of the genus.

In view of the incompleteness of the existing descriptions I give below a revised description based on the fresh material and a combination of relevant matter from the existing descriptions. The main differences between the original and my description relate chiefly to the flowers and fruit. The discrepancies are undoubtedly due mainly to imperfect herbarium material. *Randia* at the best of times is a nuisance in the herbarium on account of the rigid and often dreadfully spinous branches which not only get badly damaged themselves, but damage or destroy adjacent specimens. The large, hard fruit (when mature) is another disadvantage and is often excluded from the herbarium.

Another point worthy of note in respect to the genus *Randia* is that although the calyx and corolla are described as 5-merous they are often 6-merous and occasionally 7-merous. This I have often observed in *R. uliginosa* and *R. Brandisi.* The pubescence of the leaves and calyx is a variable character for age plays an important part—young parts are often densely pubescent finally becoming glabrous or nearly so. The presence or absence of spines is another variable character and not much reliance can be placed on this character as a rule.

Randia corymbosa Wight and Arnott, *Prodr.* (1834) p. 399, No. 1232.

Randia Candolleana W. & A. *Prodr.* (1834) p. 399, No. 1233. Hook *Fl.B.I.* vol. iii (1880) p. 113; Brandis, *Ind. Trees* (1906) p. 383; Gamble, *Fl. Madr.* pt. iv (1921) pp. 615-616.

Randia deccanensis Beddome, *Ic. Ind. Or.* t. 237.

Description: A small armed or unarmed deciduous tree with thick brown bark; young shoots pubescent. Leaves up to 150 mm. by 75 mm., broadly elliptic, obovate, or arbicular, glabrous above, pubescent beneath, petiole 18-35 mm. long. Flowers in sessile cymes (crowded terminal corymbs, *Gamble*), flowers often in pairs; bracts deciduous; calyx campanulate, 12 mm. with a constriction below the teeth, pubescent; teeth 6-7, subacute; corolla 18-25 mm. across, tube 14 mm. long (to division of lobes), silky outside, lobes 6, 13 mm. long broadly oblong, thick, grabrate within, white turning yellow with age; anthers 6 inserted at the base of the corolla lobes, linear-oblong; stigma oblong, imperfectly 4-partite at the tip. Fruit ovate, globose, or elliptical, narrowed towards the apex—69 by 25 mm., crustaceous or squamaceous (like a Sapota), on a very short stout pedicel. Seeds numerous embedded in pulp, 3-4 mm., compressed, smooth.

Distribution: Evidently confined to the dry hill forests of the Peninsula: Bombay Presidency, Madras Presidency, Mysore and Hyderabad Deccan.

Localities: Naggur Hills, (*Wight*, Hk. *f*); Nullamallai Hills, near Kurnool (*Beddome* ex Hk. *f*); Anantapur (ex Brandis); Javadi Hills (*D.B.* Jan. 1882, ex Brandis); Kambakam Hills of Chingleput (ex Gamble); Lambton's Peak in Coimbatore (ex Gamble); Katraj Ghat, near Poona, (Suter, Herb. McC. 5859 !).

I cannot conclude this record without expressing my sincere thanks to Dr. M. Suter for the specimens and for giving me this opportunity of describing this species in fuller detail.

BOMBAY NATURAL HISTORY SOCIETY. C. McCANN.

18th October, 1946.

34.—THE GENUS *CEROPEGIA*—A COMMENT.

Ceropegia Blatteri McCann.

Ceropegia Blatteri nov. comb.
C. odorata Nimmo in Graham *Cat. Bomb. Pl.* (1839), p. 118.
C odorata Hooker f. *Fl. B. I.*, V. 4 (1883), p. 75. *non Nimmo.*

It is obvious from the above synonymy that a change of the name is necessitated as the specific name *odorata* is preoccupied. The name *C. odorata* Nimmo first appeared in Graham's Catalogue in 1839. The only description accompanying the name is 'Flowers yellow, fragrant; so unusual in the genus'. In the same work there is a reference to another yellow species from Khandala, my *C. Evansii*; in Hookerf's work there is reference to a white corolla; Trimen refers to a yellow species from Ceylon. As there is room for doubt, more so on account of the *very insufficient* description of Nimmo, the name *C. odorata* must be treated as a *nomen-nudum.*"

The above observation by Mr. Charles McCann in the *Journal, Bombay Natural History Society*, Vol. 45, No. 2, April 1945 on 'New Species of Ceropegia and the synonymy of the Indian species 4' is open to criticism.

At the very outset, it should be pointed out that the name *Ceropegia Blatteri* McC. is not a new combination at all as the specific epithet *Blatteri* is new and is not an epithet of an already published species. McCann should have stated *nov. nom.* as it is a new name.

Further he evidently confuses his whole statement by noting that 'in the same work there is a reference to another yellow species from Khandala, my *C. Evansii*'. There is no reference in Graham's *Catalogue*[1] for another yellow plant. On the other hand, the floral corolla of that plant at Khandalla was described as follows: "Tube of the corolla swelled towards the base, of a dingy white, inside of the crown, rose coloured." To add to this confusion McCann's next sentence namely "in Hooker f.'s work there is a reference to a white corolla; Trimen refers to a yellow species from Ceylon," is quite ambiguous as it conveys no meaning even after referring to Hooker. f.'s *Flora of British India*[2] and *Trimen's Hand-book of the Flora of Ceylon.*

Even then, the author is not justified in changing the specific epithet from *odarata to Blatteri*, because the description of *Ceropegia odorata* given by Nimmo had been effectively published in *Graham's Catalogue of Bombay Plants* (1839)[1] and according to the article 36, section 5 read together with the article 44, section 6 of the international rules of Botanical Nomenclature, 1930, published in the *Journal of Botany*, Vol. 72, 1934[3] it had attained its validity. Even if this description is considered insufficient, as contended by McCann, the more or less complete description of *Ceropegia odorata* Nimmo published by Hooker f. in the *Flora of British India*[2] has definitely established the validity of the name. In view of these facts, the legitimacy of the name *Ceropegia odorata* Nimmo cannot be questioned.

For the reasons stated above McCann is not at all justified either in giving a new name or creating a new combination. In fact, the name *Ceropegia odorata* Nimmo stands as a good valid species as per article 44, section 6 of the international rules of Botanical Nomenclature, 1930. It is incumbent on every systematist to strictly follow the International rules of Botanical Nomenclature while dealing with taxonomical problems.

I am grateful to Mr. V. Narayanswami, M.A., Systematic Assistant, Royal Botanic Garden, Calcutta for his guidance in the preparation of this note.

SIBPUR HERBARIUM,
ROYAL BOTANIC GARDEN, CALCUTTA. R. SESHAGIRI RAO.
12th November 1946.

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4. *Journal of the Bombay Natural History Society*, Vol. 45, No. 2, April, 1945.
5. Trimen, H. *Hand book of the Flora of Ceylon, Pt. III, 1895.*

35.—NOTES ON SELF POLLINATION IN TWO ORCHIDS.

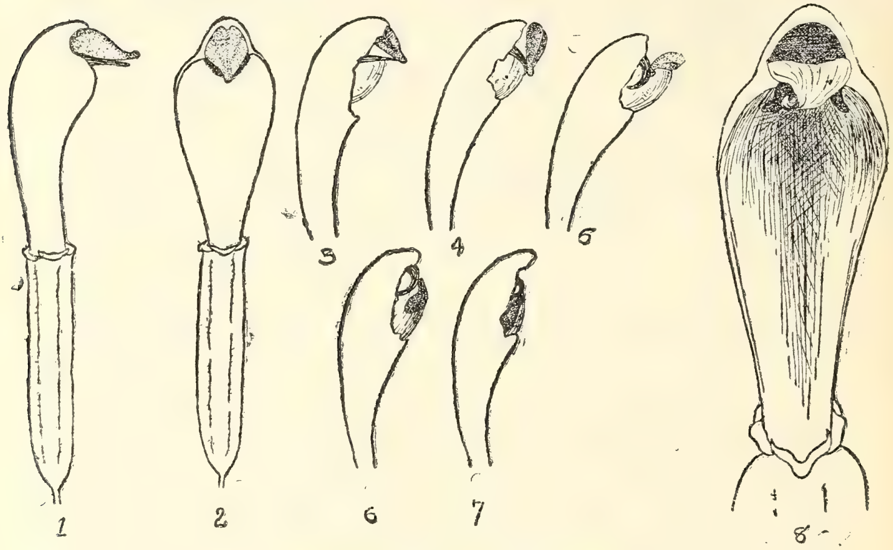
It is well known that cross pollination is universal among Orchids and that the flowers show remarkable adaptations to attain this end. This aspect has been admirably discussed by Darwin (1899) in his book, "The Various Contrivances by which Orchids are Fertilised by insects". Cases of cleistogamy are admittedly rare in the family. But still there are on record a couple of plants like *Neottia*, *Corallorrhiza*, etc., which are known to be cleistogamic habitually; there are few forms which are typically adapted for cross pollination but under certain unfavourable circumstances tend to get self pollinated. This phenomenon as met within two such Orchids are described in the following paragraphs.

Spathoglottis plicata Blume.

Though no member of this genus has been reported from South India, in a wild condition, Hooker (1894) and Brühl (1926) record a couple of species to be indigenous to the Himalayan region. *Spathoglottis plicata* is long known to horticulturists in South India and it is the commonest Orchid under cultivation, perhaps on account of its freely flowering nature and also because of its handsome foliage and flowers. Its natural home is Malay Peninsula (Bailey, 1917).

It was noticed that in spite of bagging isolated flower buds, normal seeds developed in the ovaries of such flowers. A careful examination of the plants growing in various gardens revealed a remarkable method of self pollination to take place. In the mature and newly opened flower, the gynostegium is about 3/4 to 1 inch tall; it is narrower at the bottom but becomes broadened out and enlarged in circumference higher up (Figs. 1 and 2), presenting a crescent shape in transverse section. The anther is borne terminally, the stalk of the anther being attached by a sticky substance to the underlying tongue-shaped rostellum. At maturity the anther cap which is in the form of a thin membrane is shed.

After the flower opens, one sees the accumulation of a watery drop gradually bulging out from the stigmatic surface; as the accumulation increases, the drop comes in contact with the under surface of the rostellum and the latter structure together with the attached pollinium now exhibits a strong tendency to recurve towards the stigmatic surface. This involves the pollinium to rise from its position and curl downwards. In the meantime the volume of the drop of the "stigmatic fluid" will have increased to such an extent that it touches the recurved rostellum and the pollinium from beneath and soon the latter slips down into the fluid. Now, perhaps the watery drop is withdrawn into the stigmatic cavity or it evaporates or both the phenomena operate and the result is the pollinium is drawn into the stigmatic depression (Fig. 7). Pollen grains begin to germinate in this condition and pollen tubes are seen traversing the ovary 2 to 3 days after pollination. The sequence of the above stages are represented in Figures 3 to 8.

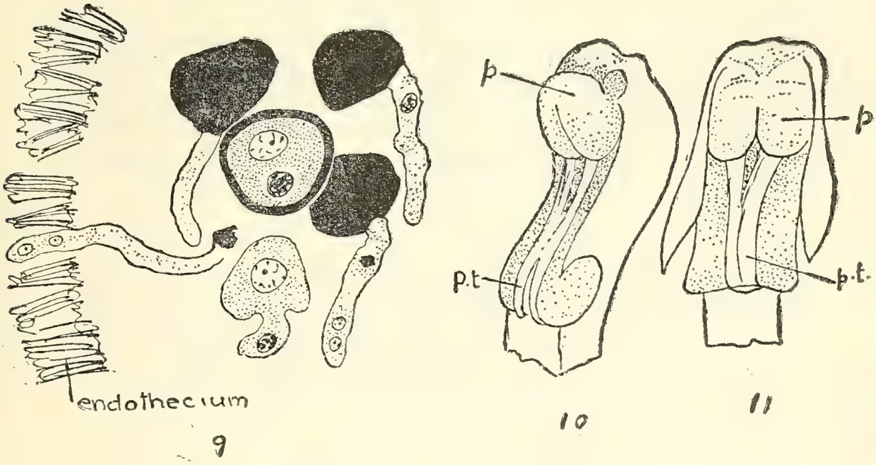


Spathoglottis plicata Blume.

Ridley (1888) observed in *Spathoglottis Paulinae* Fitzg that the pollinia slip forward at the same time remaining attached by their apex and curve round into the stigma and thus self pollination is accomplished. A similar phenomenon is noticed by the present author with regard to self pollination in *S. plicata*. In addition to this movement of the pollinium, a recurving movement of the rostellum and the accumulation of a watery exudation from the stigma in the form of a large drop is noticed in *S. plicata*, which facilitates the pollinium to slip into the stigmatic depression.

Vanilla planifolia Andr.

Vanilla Sw. is a genus of tropical climbers with fleshy stems, ascending to the top of tall trees and there producing green or yellowish flowers. The stems strike aerial roots at the nodes, which besides absorbing nutriment, act also as hold-fasts for the climbing stem. *Vanilla planifolia* is a native of Central America and is under cultivation elsewhere on account of its pods which yield the commercial aromatic Vanillin.



Vanilla planifolia Andr.
p.t.=pollen tubes
p=anther

In the native home of *Vanilla planifolia*, the flowers are pollinated by small bees of the genus *Meliope* (Rolfe, 1909). Under cultivation hand pollination is practised. In Bangalore some plants have been cultivated for a very long time by some nursery-men, mainly with the idea of collecting and marketting the pods for local consumption. The writer gathered from the cultivators that they artificially pollinated (mostly selfed) the flowers but that some times normal pods developed even without any attempt at pollination. This latter phenomenon was confirmed by the present writer when he bagged individual flower buds on the plant and watched the progress.

Very frequently the pollen grains of the cultivated *Vanilla planifolia* put forth pollen tubes while still within the anther sac; division of the generative cell into male nuclei was also seen in such pollen tubes (Fig. 9). The endothecium ruptures at irregular intervals. Pollen tubes from the anther sac grow downwards and reach the stigmatic surface and from this point enter the cavity of the gynostegium (Figs. 10 and 11). Fertilisation by the contents of these pollen tubes were seen to be normal and also the post-fertilisation development, which will be published elsewhere.

It is well known that the structure of the flower of *Vanilla planifolia* is specially suited for pollination only by insects in nature. Pollen grains of this plant are according to Rolfe (1909) "simple and held together by viscid matter, not by elastic threads". This condition may be quite true of the plants growing in their natural habitat, but in those cultivated plants observed by the writer there are free pollen grains with thick exine, which feature becomes evident even at the uninucleate stage of the microspores. Further, they germinate in the very pollen sacs. These characters may well be explained only as facultative adaptations of the plant to an unfavourable environment, where cross pollination is prevented due to the absence of the required insect visitor.

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BASVANGUDI,
BANGALORE,
15th August, 1946.

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